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Draft Final (FINAL VERSION)

Work Plan
and
Sampling and Analysis Plan
Post Remediation Ecological Monitoring
Camp Allen Landfill

Norfolk Naval Base
Norfolk, Virginia

Prepared for

Department of the Navy
Atlantic Division
Naval Facilities Engineering Command

Contract No. N62470-95-D-6007
CTO-0011

August 1996

Prepared by

CH2M HILL
Federal Group, Ltd.

SIGNATURE PAGE

Draft Final Work Plan

Camp Allen Landfill
Post Remediation Ecological Monitoring
Norfolk Naval Base
Norfolk, Virginia

Navy CLEAN II Program
Contract Number N62470-95-D-6007
Contract Task Order 0011

Prepared by

CH2M HILL Federal Group, Ltd.

August 1996

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Section 1

Introduction

This Work Plan describes the work necessary to conduct additional surface water and sediment sampling and analysis, perform a literature review, and prepare a revised Ecological Risk Assessment (ERA) of the Bousch Creek drainage feature at Norfolk Naval Base, Virginia. Remediation is being implemented to address groundwater and soils contamination at the Camp Allen Landfill (CAL). The additional monitoring results will be used to supplement the results of the previous Ecological Assessment of the landfill area.

A review of the Remedial Investigation, Baseline Risk Assessment, and Feasibility Study for CAL by the Environmental Protection Agency's Biological Technical Assistance Group (BTAG) resulted in a wide range of comments concerning the extent of contaminants in the drainage area. The Navy developed a scope of additional study necessary to complete a quantitative ERA.

The scope of work for this task order requires CH2M HILL to:

- Sample surface water and sediments of Bousch Creek
- Calculate ecological risks (revise existing ERA)
- Review Bousch Creek contaminant sources and hydrology
- Research regional impacts to Willoughby Bay

The revised ERA will be a self-contained / stand-alone ERA that includes the data collected via this scope of work. The work shall be accomplished as noted in the tasks described below.

This Work Plan is based upon a Scope of Work provided by Naval Facilities Engineering Command (NFEC) LANTDIV on May 2, 1995, as part of Navy Contract N62470-95-D-6007, Navy CLEAN II, District III, Contract Task Order - 011, and the technical approach as documented in CH2M HILL's Implementation Plan (IP) submitted to LANTDIV on March 13, 1996.

The general background and physical setting of Norfolk Naval Base is described in Section 2 of this Work Plan. Section 3 presents initial evaluations of the Bousch Creek drainage feature, based upon the results of previous investigations and an initial site visit, and the rationale that supports the sampling tasks. Section 4 describes the technical approach for sampling, research, and reporting tasks. Section 5 presents the staff organization. Section 6 describes contractual services necessary for this task order. Section 7 presents the schedule for completion of these tasks. A list of acronyms used in this work plan is presented in Table 1-1.

TABLE 1-1

Acronyms and Abbreviations

AOC	Areas of Concern
ASTM	American Society of Testing Materials
BOA	Basic Order Agreement
BTAG	Biological Technical Advisory Group
C	Centigrade
CAL	Camp Allen Landfill
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
CTO	Contract Task Order
DEQ	Department of Environmental Quality
DOD	Department of Defense
ECOC	Ecological Chemicals of Concern
EEQ	Environmental Effects Quotient
EPA	Environmental Protection Agency
ERA	Ecological Risk Assessment
F	Farenheit
FSP	Field Sampling Plan
FWS	Fish and Wildlife Service
HASP	Health and Safety Plan
HCl	Hydrochloric Acid
HNO_3	Nitric Acid
IAS	Installation Assessment Study
IDWMP	Investigation Derived Waste Management Plan
IP	Implementation Plan
IRP	Installation Restoration Program
IRPRI	Installation Restoration Program-Interim Report
LANTDIV	U.S. Navy Naval Facilities Engineering Command, Atlantic Division
LQAP	Laboratory Quality Assurance Plan
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MSL	Mean Sea Level

TABLE 1-1

Acronyms and Abbreviations

NaOH	Sodium Hydroxide
NOAA	National Oceanic and Atmospheric Administration
NAS	Naval Air Station
NFEC	Navy Facilities Engineering Command
NPL	National Priorities List
NTR	Naval Technical Representative
NWS	National Weather Service
OLC02	EPA analytical method for Organic Low Concentration Water
PCB	Polychlorinated biphenyl
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
SAP	Sampling and Analysis Plan
SMP	Site Management Plan
SOW	Statement of Work
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TCL	Target Compound List
TOC	Total Organic Carbon
US	United States
USGS	United States Geological Survey
VOA	Volatile Organic Analysis
VOCs	Volatile Organic Compounds
VSI	Visual Site Inspection

Section 2

Site Background and Physical Setting

Available site background information is documented in this section. Information was obtained primarily from the Norfolk Naval Base Resource Conservation and Recovery Act (RCRA) Facility Assessment Report prepared by A.T. Kearney, Inc., 1992, and the Site Management Plan prepared by Baker Environmental, Inc., 1995.

Location and Surrounding Land Use

Norfolk Naval Base, is located on 4,631 acres of land directly northwest of the city of Norfolk, Virginia. The facility is bounded on the north by Willoughby Bay, on the west by the junction of the Elizabeth River and the James River (forming the Hampton Roads), and on the south and east by the city of Norfolk. A portion of the east boundary of the facility is formed by Mason Creek (Figure 2-1). The base includes approximately 4000 buildings and an airfield. The western portion of the base is a developed waterfront area that contains piers and facilities for loading, unloading, and servicing naval vessels.

Land use surrounding the base is industrial and residential. The waterfront area south of the site provides shipping facilities for several large industries. Residential land use is located to the south and east of the base. Willoughby Spit, a low-density residential area located northeast of the base, is also used for recreational activities.

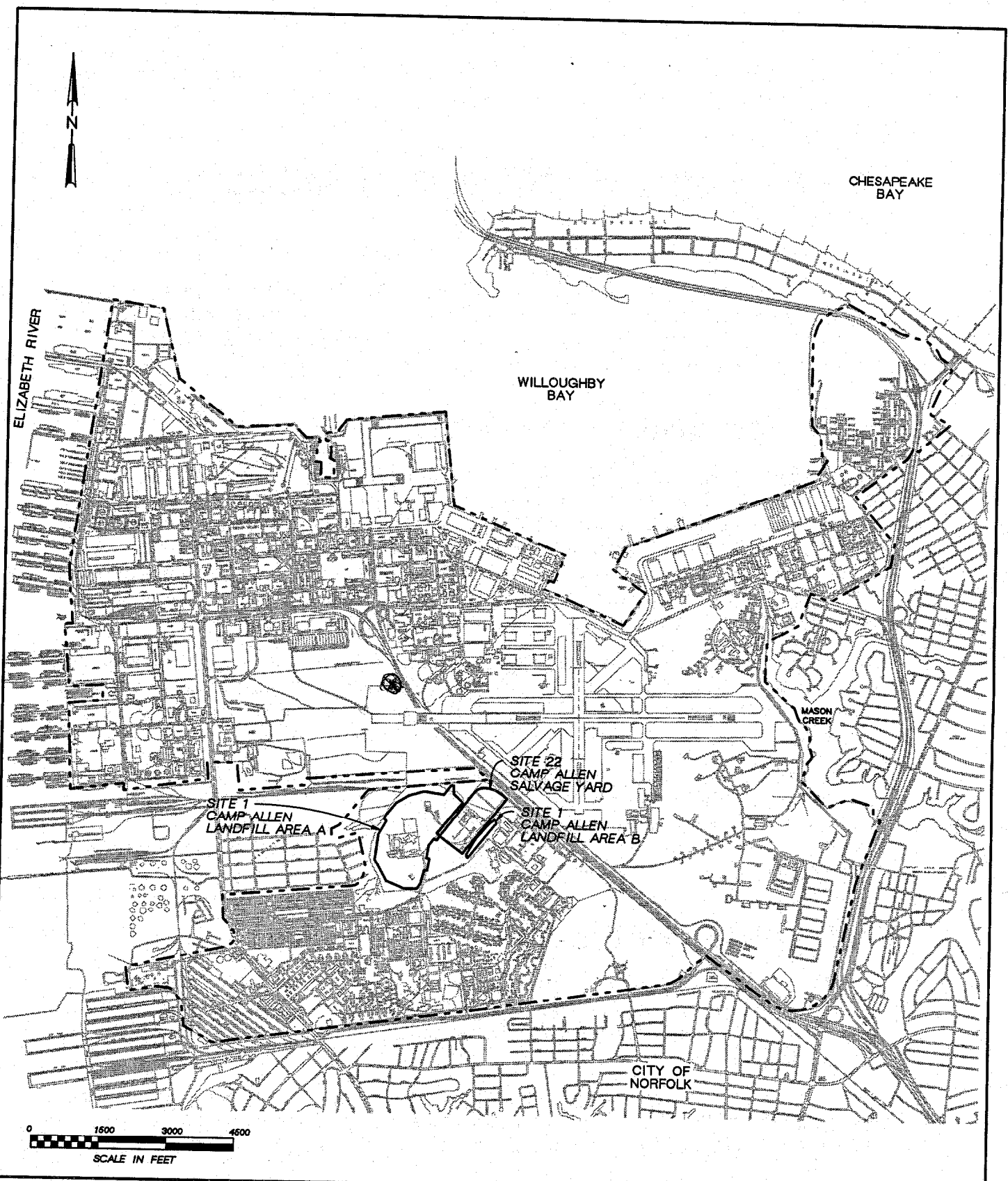
A large concentration of military installations are located within a 25-mile radius of the base. These include Fort Monroe and Langley Air Force Base to the north, Naval Amphibious Base and Fort Story to the east, Naval Air Station Oceana to the southeast, Norfolk Naval Shipyard and St. Juliens Creek Annex to the south, and Naval Supply Center-Craney Island Fuel Terminal to the southwest.

Facility History and Mission

Norfolk Naval Base, began operations in 1917 when the U.S. Navy acquired 474 acres of land to develop a naval base to support World War I activities. Bulkheads were built along the coast to extend available land. After dredge and fill operations, the total land under Navy control was 792 acres.

An additional 143 acres of land were acquired in 1918 and officially commissioned for the Naval Air Station (NAS). From 1936 until 1940, improvements to the piers and expansion of supplies/materials handling facilities were completed.

During World War II (between 1940 and 1945) major construction projects were completed, including a hospital, power plant, numerous runways and hangers, a tank farm, and several barracks/housing complexes. During this time, the area of the base expanded to over 2,100 acres as the scope of Base activities grew to United States (U.S.) involvement in World



LEGEND

PROPERTY BOUNDARY - NORFOLK NAVAL BASE

Figure 2-1
SITE LOCATION MAP
Norfolk Naval Base

CH2M HILL

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War II. After World War II, the base continued to acquire land through various types of land transfers and dredge and fill operations conducted in areas of Mason Creek and Bousch Creek Basins and Willoughby Bay. During its history the Base has expanded to become the world's largest naval installation. In 1995, the base had 15 piers handling 3,100 ship movements annually.

The mission of the Norfolk Naval Base, is to provide fleet support and readiness for the U.S. Atlantic Fleet. The mission is four-fold: 1) to command assigned naval shore activities; 2) to coordinate support to afloat units, their air arm, and other naval activities; 3) to act as regional area coordinator; and, 4) to act as senior officer present afloat for administration in the Hampton Roads area.

Operations/Process Description

Norfolk Naval Base provides shore facilities and logistics support for U.S. military vessels and aircraft. As such, the facility operates in various capacities, such as providing housing, hospital care, recreation, and training for the military personnel; providing supplies to the fleet; serving as a repair site for aircraft, navy vessels, and associated equipment; and transporting, disposing, and recycling wastes generated at the base and at other federal facilities within a 50-mile radius.

Service and maintenance of home-ported ships or visiting ships include defueling, refueling, utilities hookup, on board intermediate maintenance, and coordination of ship movements in the harbor. The industrial functions are unloading, offloading, and handling of fuels and oils (including used oils) used aboard the vessels. Maintenance and repair functions include repair and sandblasting of ship hulls, parts cleaning and testing, and painting. Aircraft repair and maintenance operations include stripping, patching, parts cleaning, repainting of fiberglass hauls, engine overhauls, installation of new electronic gear, and metal plating using nickel, silver, and chrome. Other industrial operations carried out by tenants include firefighting training, laboratory analyses, asbestos removal, printing, pest control, and construction-related activities.

Climate and Meteorology

The Norfolk region has a maritime climate which is characterized by long temperate summers and mild winters. The average annual temperature is 60.7 degrees Fahrenheit (F). July is the warmest month, with temperatures averaging 78.7 degrees F; while January is the coolest month, with temperatures averaging 43.1 degrees F. Freezing temperatures are infrequent in the region. Precipitation averages 43 inches annually and is evenly distributed throughout the year. A slight increase in precipitation occurs from June to August due to the prevalence of convective thunderstorms. The average annual snowfall is 8.8 inches. Winds are generally in the easterly direction and moderate, ranging from six to eleven knots.

Topography, Surface Drainage, and Soils

The topography of Norfolk Naval Base is nearly level. Surface elevations at the site range from sea level to 15 feet, found in the central section of the base.

Four major surface water features surround the greater Norfolk area including the James and Elizabeth Rivers and Willoughby and Chesapeake Bays, all of which are tidal.

The majority of surface water on the base flows either to Mason Creek or to the remnants of Bousch Creek. The northernmost channel of Mason Creek traverses the base and empties into Willoughby Bay via a subgrade aqueduct. The main channel of Bousch Creek was filled in and replaced by a network of drainage ditches during the development of the base. These narrow, drainage channels are interspersed throughout the central part of the facility. Both Mason Creek and facility drainage ditches are tidal throughout the site. Both creeks discharge to Willoughby Bay and ultimately, to the Chesapeake Bay. Some surface water from the base discharges directly into the Elizabeth River.

The reported 100-year static water flood elevation throughout the base site is 8.5 feet above mean sea level (MSL). Therefore, portions of the base adjacent to Willoughby Bay and the Elizabeth River are within the 100-year floodplain.

Soils at the base generally consist of fine sands and silts with a thickness of 20 to 40 feet having low to moderate permeability. This upper layer of soils are typically underlain by relatively impermeable sediments comprised of silt, clay, and sandy clay. Together, these strata have a combined thickness of approximately 60 feet. The average permeability of soils in Norfolk County is less than 2.5 inches per hour.

Geology and Hydrogeology

Naval Base, Norfolk is located in the outer Atlantic Coastal Plain Physiographic Province which is characterized by low elevations and gently sloping relief. The Base is underlain by over 2,000 feet of gently dipping sandy sediments, ranging in age from Recent to Lower Cretaceous. Table 2-1 contains a stratigraphic column and hydrogeologic units of southeast Virginia.

The uppermost geologic unit is the Columbia Group, composed of Holocene deposits and undifferentiated Pleistocene deposits. The Columbia Group is approximately 60 feet thick. The upper 20 to 40 feet consist of unconsolidated fine sands and silts. These sediments possess low to moderate permeabilities and comprise the unconfined Columbia aquifer. The lower 20 to 40 feet consist of relatively impermeable silt, clay, and sandy clay.

The Chesapeake Group underlies the Columbia Group. The uppermost unit in the Chesapeake Group is the Yorktown Formation. It is capped by the Yorktown confining unit that separates the Columbia aquifer from underlying Yorktown aquifer. The Yorktown formation is approximately 90 to 100 feet thick in the vicinity of the Base and is composed of marine silt and clay and moderately consolidated coarse sand and gravel with abundant shell fragments. The Chesapeake Group is composed of several additional older formations that comprise deeper aquifers and confining units. These overlie the Tertiary Pamunkey Group and Cretaceous stratigraphy.

The two significant shallow aquifer systems in the area are the Columbia aquifer located in the upper 20 to 40 feet of the Columbia Group, and the underlying Yorktown Aquifer. The Columbia aquifer comprises the water table aquifer is reportedly thin and consists of discontinuous heterogeneous sand and shell lenses. The depth to the water table is usually

Table 2-1
Stratigraphic and Hydrogeologic Units
of Southeast Virginia
(From Harsh and Laczniak, 1990)

Geologic Age		Group	Stratigraphic Formation	Hydrogeologic Unit
Period	Epoch			
Quaternary	Holocene	Columbia	Holocene Deposits	Columbia Aquifer
	Pleistocene		Undifferentiated Deposits	
Tertiary	Pliocene	Chesapeake	Yorktown Formation	Yorktown Confining Unit
				Yorktown- Eastover Aquifer
	Miocene		Eastover Formation	
			St. Mary's Formation	St. Mary's Confining Unit
			Choptank Formation	St. Mary's-Choptank Aquifer
			Calvert Formation	Calvert Confining Unit
	Oligocene	Pamunkey	Old Church Formation	Chickahominy-Piney Point Aquifer
	Eocene		Chickahominy Formation	
			Piney Point Formation	
			Nanjemoy Formation	Nanjemoy-Marlboro Clay Confining Unit
			Marlboro Clay	
	Paleocene		Aquia Formation	Aquia Aquifer
			Brightseat Formation	Brightseat-Upper Potomac Confining Unit
Cretaceous	Late Cretaceous		Potomac Formation	Brightseat-Upper Potomac Aquifer
				Middle Potomac Confining Unit
	Early Cretaceous			Middle Potomac Aquifer
				Lower Potomac Confining Unit
				Lower Potomac Aquifer

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less than 8 feet. The Yorktown Aquifer is semi-confined beneath a clay layer in the upper Yorktown Formation. Water bearing zones in the Yorktown Aquifer consist of fine to coarse sand, gravel, and shells.

Environmental History

Information regarding previous and ongoing basewide hazardous waste investigations are documented below. The Installation Restoration Program (IRP) is described first. Then summary information from previous basewide hazardous waste investigations is documented. Finally, ongoing basewide hazardous waste investigations are summarized.

Installation Restoration Program

Currently, Norfolk Naval Base is not on the United States Environmental Protection Agency (EPA) National Priorities List (NPL). Therefore, the Navy is acting as the lead agency in environmental investigations at the base. The environmental condition of the base is being investigated through the Department of Defense's IRP. The IRP at Norfolk Naval Base, has been conducted in accordance with applicable federal and state environmental regulations and requirements. In addition, the Navy has requested involvement and input from the federal and state regulatory agencies, (USEPA and the Virginia Department of Environmental Quality (DEQ)) throughout the IRP process by submitting documents for their review.

In 1975, the Department of Defense (DOD) began a program to assess past hazardous and toxic materials storage and disposal activities at military installations. The goals of this program, now known as the IRP, were to identify environmental contamination resulting from past hazardous materials management practices, to assess the impacts of the contamination on public health and the environment, and to provide corrective measures as required to mitigate adverse impacts to public health and the environment.

In 1976, RCRA was passed by Congress to address potentially-adverse human health and environmental impacts of hazardous waste management and disposal practices. RCRA was legislated to manage the present and future disposal of hazardous wastes. In 1980, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), or "Superfund", was passed to investigate and remediate areas resulting from past, hazardous waste management practices. This program is administered by the USEPA or state agencies.

In 1981, the DOD's IRP was re-issued, with additional responsibilities and authorities specified in CERCLA delegated to the Secretary of Defense. The Navy subsequently restructured the IRP to match the terminology and structure of the USEPA CERCLA Program. The current IRP is consistent with CERCLA and applicable state environmental laws.

Previous Base-Wide Investigations

Previous base-wide investigations completed through the IRP include the Initial Assessment Study (IAS), dated February 1983, the IRP Remedial Investigation - Interim Report (IRPRI), dated March 1988, and a draft RCRA Facility Assessment (RFA), completed for Norfolk Naval Base in February 1991, revised in March, 1992.

The purpose of the 1983 IAS was to identify and assess sites that posed a potential threat to human health and/or the environment due to contamination from past hazardous materials handling and operations. A total of 18 potentially contaminated sites, designated Sites 1 through 18, were identified based on information obtained from historical records, photographs, site inspections, and personnel interviews. Each of the 18 sites was evaluated for the type of contamination, migration pathways, and pollutant receptors. The IAS concluded that 6 of the 18 sites posed sufficient threats to human health or the environment to warrant further evaluation in a confirmation study. Sampling and analyses were not performed as part of the IAS. During the confirmation study, sampling and monitoring would be performed at the site to confirm or refute the existence of the suspected contamination.

A confirmation study was subsequently performed for the six sites which were recommended for further investigation in the IAS. This effort for five of the six sites was documented in the 1988 IRPRI Report. An independent confirmation study was performed by the Navy on Site 6 - the CD Landfill. The objectives of the confirmation study were to determine the extent of contamination, develop and evaluate economically feasible remedial alternatives, and recommend a remedial action at the following five sites:

- Site 1 - Camp Allen Landfill
- Site 2 - NM Area Slag Pile
- Site 3 - Q-Area Drum Storage Yard
- Site 4 - Transformer Storage Area P-71
- Site 5 - Pesticide Disposal Site

Since the 1983 IAS, four additional IRP sites (Sites 19 through 22) have been identified and have been added to the IRP.

During the course of the on-going IRP at Norfolk Naval Base, several site-specific remedial investigations, feasibility studies, removal actions, and site remediations have been competed or are in progress. Remediations have been completed or are in progress at six sites (Sites 1, 4, 11, 16,17, and 19), as indicated in Table 2-2.

A Draft RFA was completed for Norfolk Naval Base in February 1991. This study was a base-wide inventory of existing solid waste management units (SWMUs) and other Areas of Concern (AOCs) on the base. A total of 274 SWMUs and 10 AOCs were tentatively identified in this study. The Navy has selected three of the SWMUs for investigation and evaluation under the IRP. A comprehensive review of these potential sites was accomplished prior to finalizing the RFA in March, 1992.

A Site Management Plan (SMP) was developed for Norfolk Naval Base by Baker Environmental, Inc., in 1995. The SMP provided LANTDIV with a management tool to plan, schedule, and prioritize environmental remedial response activities to be conducted at the base in 1996.

Current Base-Wide Investigations

LANTDIV has awarded the Navy CLEAN II Contract to CH2M HILL. Under this contract, several contract task orders (CTOs) that pertain to investigations at Norfolk Naval Base have been issued as of the date of preparation for this work plan. These include the following:

CTO-3	Remedial Investigation/Feasibility Study of the Pesticide Disposal Site (Site 5)
	Preliminary Assessment/Site Investigation of the Building 316, Polychlorinated Biphenyl (PCB) Waste Work Area (Site 21)
CTO-5	Remedial Action Design Package for the LP-20 Site
CTO-7	Remedial Action Design Package for the CD Landfill Site
CTO-8	Remedial Investigation/Feasibility Study of the NM Slag Pile (Site 2)
CTO-11	Camp Allen Landfill, Post Remediation Ecological Monitoring
CTO-12	Solid Waste Management Unit Investigation (SWMUs 1, 4, 6, and 8)

Table 2-2

CURRENT STATUS SUMMARY IRP SITES

NAVAL BASE NORFOLK SITE MANAGEMENT PLAN

	Site	PA or IAS	SI or CS	TBA	Work Plans	RI	FS	PRAP	ROD	RD	RA	Comments
1.	Camp Allen Landfill	1983*	1988*		1991	1994	1994	1995	√	√	√	Removal action (soil) completed. Long-term groundwater pump & treat being implemented.
2.	NM Slag Pile	1983*	1988*		√	√	√	0	0			Limited sampling program revealed only minimal contamination.
3.	Q-Area Drum Storage	1983*	1988*		1991	√	√	√	√	√	0	Soil contamination - TPH, VOCs, pesticides. VOC-contaminated groundwater. Remedial Design in progress. RI/FS underway.
4.	P-71 Transformer Storage	1983*	1988*		1991	1991	1991	1991	1992	1991	1992	Cleanup completed. Groundwater monitoring completed in 1995.
5.	Pesticide Disposal Site	1983*	1988*		√	√	√	0	0			Pesticide-contaminated soil. No documented groundwater contamination. RI/FS underway.
6.	CD Landfill	1983*	1991		1993	1995	1995	√		√	0	Heavy metal-contaminated soil/groundwater. RI/FS in progress.
7.	Insert Chemical Landfill	1983*		0								State-approved, non-hazardoius waste landfill. No further action recommended per IAS.
8.	Asbestos Landfill	1983*		0								State-approved, non-hazardoius waste landfill. No further action recommended per IAS.
9.	Q-Area Landfill	1983*		0								Constructin debris only landfill. Nor further action recommended per IAS.
10.	Apollo Disposal Sites	1983*		0								Apollo fuel component has most likely biodegraded. No further action recommended per IAS.
11.	Repair Shop Drains	1983*		0							X	Cleanup completed. No further action recommended per IAS.
12.	Mercury Disposal Site	1983*		0								No evidence of mercury disposal found. No further action recommended per IAS.
13.	Past Wastewater Outfalls	1983*		0								Industrial wastewater rerouted to treatment plant. No further action recommended per IAS.
14.	Oil Spill - Piers 4, 5, 7	1983*										Site being addressed under the UST Program - no longer an IRP Site.
15.	Oil Spill - Piers 20, 21, 22	1983*										Site being addressed under the UST Program - no longer an IRP Site.
16.	Fire, Building X-136	1983*		0							X	Cleanup completed. No further action recommended per IAS.
17.	Fire, Building SDA-215	1983*		0							X	Cleanup completed. No further action recommended per IAS.
18.	Former NM Waste Storage	1983*		0								State landfill permit issued. No further action recommended per IAS.
19.	Buildings V-60/V-90	1988	1988		1989	1989	1989	1989	1990	1989	1991	Cleanup completed. No further action recommended per IAS.
20.	LP-20 Site	1991	1991		1994	√	√	0	0	√		PA/SI documented TPH and chlorinated solvents in groundwater. RI/FS in progress.
21.	Building W-316	√	√		√							PA/SI underway.
22.	Camp Allen Salvage Yard	1994	1994		√	√	√	0	0			PA/SI documented soil and groundwater contaminatiuon. RI/FS scheduled.

LEGEND:

- 1993 - Year Activity Completed
- X - Activity Completed (date unknown)
- √ - Activity In Progress
- 0 - Activity Planned
- PA - Preliminary Assessment
- IAS - Initial Assessment Study
- SI - Site Inspection
- CS - Confirmation Study
- RI - Remedial Investiagion
- FS - Feasibility Study
- PRAP - Proposed Remedial Action Plan
- ROD - Record of Decision or Decision Document
- RD - Remedial Design
- RA - Remedial Action
- TBA - To Be Addressed

* Refers to "Initial Assessment Study of Sewells Point Naval Complex," dated February 1983.

** Refers to "Installation Restoration Program Remedial Investigation Interim Report," dated March 1988.

*** TBA sites were not recommended for further action in the 1983 IAS; however, it is recognized that these sites may need to be addressed at some point in response to changing regulatory requirement.

Section 3

Initial Evaluation and Work Plan Rationale

This section presents an initial evaluation of available background information and existing conditions for the Bousch Creek drainage feature. The rationale for the selection of sample collection locations is developed through the review of previous investigations and the findings from the CH2M HILL visual site inspection (VSI). Sampling techniques and analytical methods proposed for the CAL ecological monitoring are documented in Section 4.

Background Information for the Bousch Creek Drainage Feature

The Bousch Creek system is a complex assemblage of surface drainages that were significantly altered during the development of Naval Base, Norfolk. One segment, approximately 3,500 feet long, is below ground. The segment south of the underground component is channelized with concrete and wooden bulkhead walls. The alignment of the creek in most areas appears to have been altered to accommodate individual developments on the base.

Prior Study

The Final Remedial Investigation and Risk Assessment Report for the CAL included an ERA that assessed risks to aquatic receptors within the upper reaches of the Bousch Creek watershed. The BTAG did not feel that the ERA adequately addressed the threat posed to aquatic life by the CAL site. Remedial measures are being implemented that provide source removal and source containment, as well as treatment. These measures were implemented to control the further migration of contaminants of concern into the drainage ditches.

CH2M HILL Visual Site Inspection Findings

In March, 1996 CH2M HILL personnel conducted a VSI of the Bousch Creek drainage feature. Segments of Bousch Creek were observed to identify potential access points for field teams and equipment. During this visit, observations were made of channelization of the creek. In addition, observations were made of numerous outfall pipes ending at the creek. The existing data review (Task 3 of the Work Plan) includes the collection of data from onsite resources and regulatory agencies to determine the types of discharges entering Bousch Creek.

Section 4

Ecological Monitoring Tasks and Investigation Procedures

This section details the technical approach developed to perform the post-remediation ecological monitoring, literature review and ERA of the Bousch Creek drainage feature. The tasks included in the technical approach are listed below; the remainder of this section provides detailed discussions of each task.

Task 1: Project Planning
Task 2: Field Investigation
Task 3: Data Review
Task 4: Hydrological Studies
Task 5: Ecological Risk Assessment

Task 1: Project Planning

This task consists of the development of this Work Plan and the Sampling and Analysis Plan (SAP). Meetings and project management activities also are covered under project planning.

Work Plan

This task consists of the development of this Work Plan for performing all activities associated with the Ecological Monitoring at the Camp Allen Landfill.

Sampling Plan

This task consists of the preparation of a SAP, which is comprised of a Quality Assurance Project Plan (QAPP), a Field Sampling Plan (FSP), a Health and Safety Plan (HASP), and an Investigation Derived Waste Management Plan (IDWMP). The SAP will be developed in compliance with all requirements of the U.S. Navy Quality Assurance/Quality Control (QA/QC) Program Manual.

CH2M HILL has prepared a QAPP that meets requirements as specified by the Navy. The QAPP describes the QA/QC procedures used for conducting sediment and surface water sampling activities as part of CTO-0011, Ecological Monitoring at the Camp Allen Landfill. The QAPP is included in the SAP attached to this Work Plan.

The FSP will be referenced during field activities as procedural guidance for all sampling and data collection activities. The FSP includes the following sections: Site Background, Sampling Objectives, Sample Locations and Frequency, Sample Designations, Sampling Equipment and Procedures, and Sample Handling and Analysis. The FSP is included in the SAP attached to this document.

A site-specific HASP is prepared to provide guidance for the health and safety of CH2M HILL employees during the CAL ecological monitoring field activities.

The HASP includes health and safety assessments to identify problem areas where exposure to hazardous substances in water, soil, and air may occur. The assessments address safe working procedures, restrictions that will apply to the site work, and potential human exposure to hazardous substances and the toxicological effects of these substances.

The HASP will be used by CH2M HILL personnel and subcontractors during field activities associated with the project. All CAL ecological monitoring investigations will proceed under Level D of Personal Protection.

The IDWMP describes the procedures used for the handling and disposal of waste materials generated during the ecological monitoring program. These materials will include health and safety disposable items, sediments and fluids. The plan also describes the chemical analyses to be performed for characterizing the IDW materials and the potential means of disposal. The potential disposal sites shall also be identified. The IDWMP is included in the SAP attached to this document.

CH2M HILL will not begin field sampling at the site until the Naval Technical Representative (NTR) receives confirmation that the laboratory and its Laboratory Quality Assurance Plan (LQAP) requirements have been met for that site. The subcontracted analytical laboratory will be Navy-certified and will conform to the Navy Installation Restoration Laboratory Quality Assurance Guide, February 1996. The laboratory must have its LQAP approved before CH2M HILL will select labs under this contract.

Meetings

A one-day meeting is planned to discuss the contents of the draft ERA and any recommendations, prior to the submittal of the final report.

Project Management

The activities involved in project management include daily technical support and guidance, budget and schedule review and tracking, preparation and review of invoices, personnel resources planning and allocation, subcontractor coordination, preparation of monthly progress reports, and communication and coordination of events with LANTDIV and the Base. Project Management will occur over the duration of the project, which is estimated to be completed in 12 months after the notice-to-proceed.

Task 2: Field Investigation

Overview

Sediment and surface water samples shall be collected at each of 14 locations. The samples will be collected at the approximate locations shown on site map provided in Attachment A of the Scope of Work, *Response to USEPA Comments*. These locations have previously been submitted for comment and review by the regulatory agencies and form the basis for where the CAL ecological monitoring samples should be collected. At each location, a sediment sample will be taken along with two surface water samples: one at low tide and one at high tide. Sediment samples will be collected using a method to isolate the sample to prevent wash through or rinsing by the water column. Field measurements shall be collected at each location including, dissolved oxygen, pH, salinity, specific conductivity, hardness, and temperature.

During the field effort, daily reports will be prepared using the LANTDIV standardized reporting form. Field reports will be submitted to the Navy's Remedial Project Manager beginning no later than one week after the initiation of field activities. Multiple submissions may be necessary based on the scope of field activities on a given day.

Each sediment sample will be analyzed for full Target Compound List (TCL) organics and Target Analyte List (TAL) inorganics, Total Organic Carbon (TOC), and grain size. Surface water samples will have the same analyses, except for grain size. Volatile organic compounds (VOCs) will be analyzed by the Contract Laboratory Program (CLP) Statement of Work (SOW) for Low Concentration Water (OLC02). OLC02 will achieve the lower detection limits required for ecological risk assessment.

Sampling and Analysis

Surface water sampling

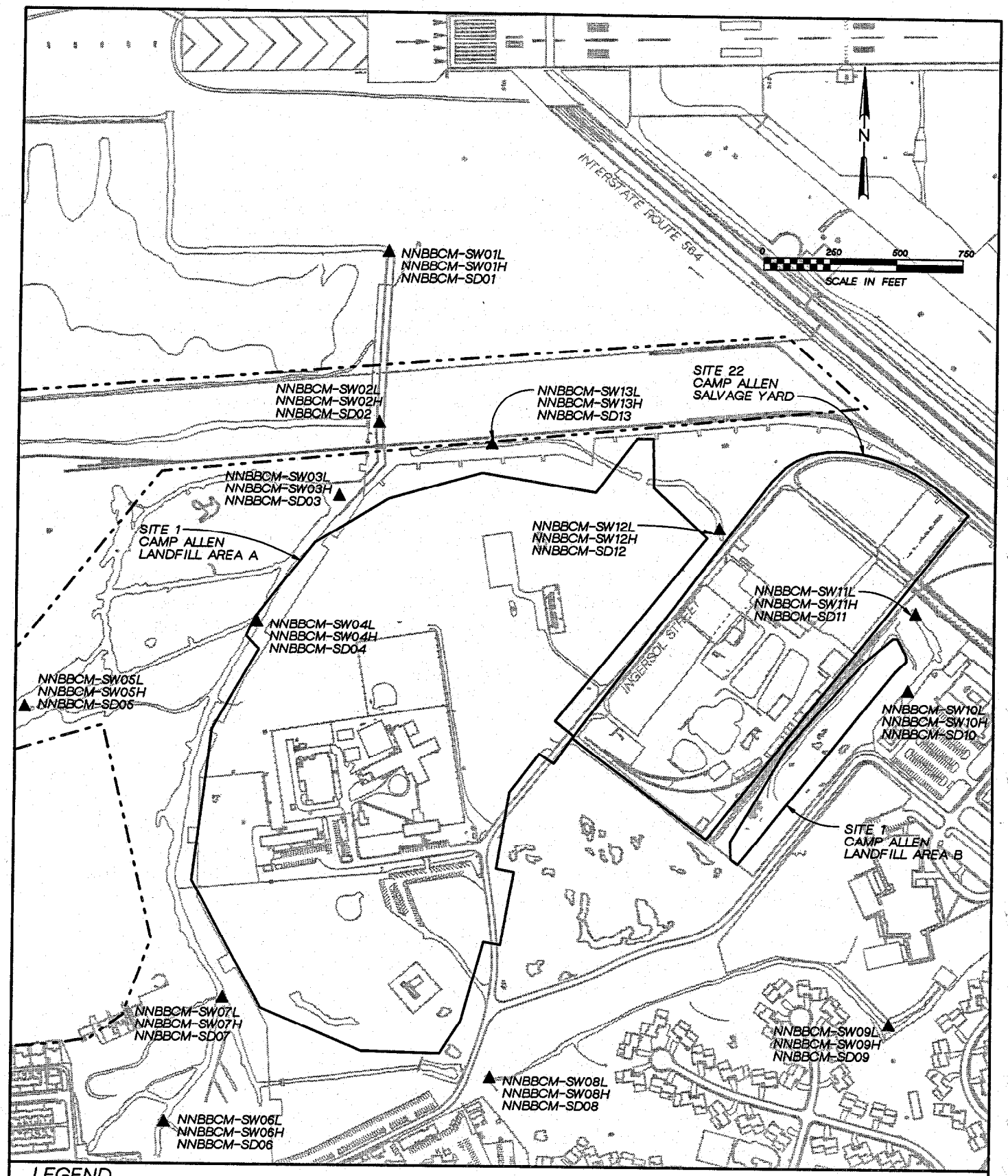
Surface water samples will be collected from the approximate locations designated in the scope of work and shown on Figures 4-1 and 4-2. Each location will be sampled at both high and low tide. An analysis of these surface water samples will facilitate an assessment of the horizontal distribution of surface water contamination.

EPA standard methods will be followed during sample analysis. Samples collected and specific analyses performed are tabulated in Table 4-1. Figures 4-1 and 4-2 provide the locations of the surface water samples listed in Table 4-1.

Sediment Sampling

A sediment sample will be collected from each of the surface water sampling locations documented above. These sediment samples will be collected from channel locations that appear to represent depositional areas in Bousch Creek. Areas with active scour should be avoided. An analysis of these sediment samples will facilitate an assessment of the horizontal distribution of sediment contamination in Bousch Creek derived within the watershed.

All sediment samples will be analyzed for TCL organics, TAL inorganics, TOC, and grain size. EPA standard methods will be followed during sample analysis. Samples to be



LEGEND

▲	SURFACE WATER QUALITY AND SEDIMENT SAMPLING LOCATION
SW H	SURFACE WATER - HIGH TIDE
SW L	SURFACE WATER - LOW TIDE
SD	SEDIMENT
— - — - —	PROPERTY BOUNDARY - NORFOLK NAVAL BASE

Figure 4-1
PROPOSED SURFACE WATER QUALITY AND SEDIMENT SAMPLING LOCATIONS
Norfolk Naval Base

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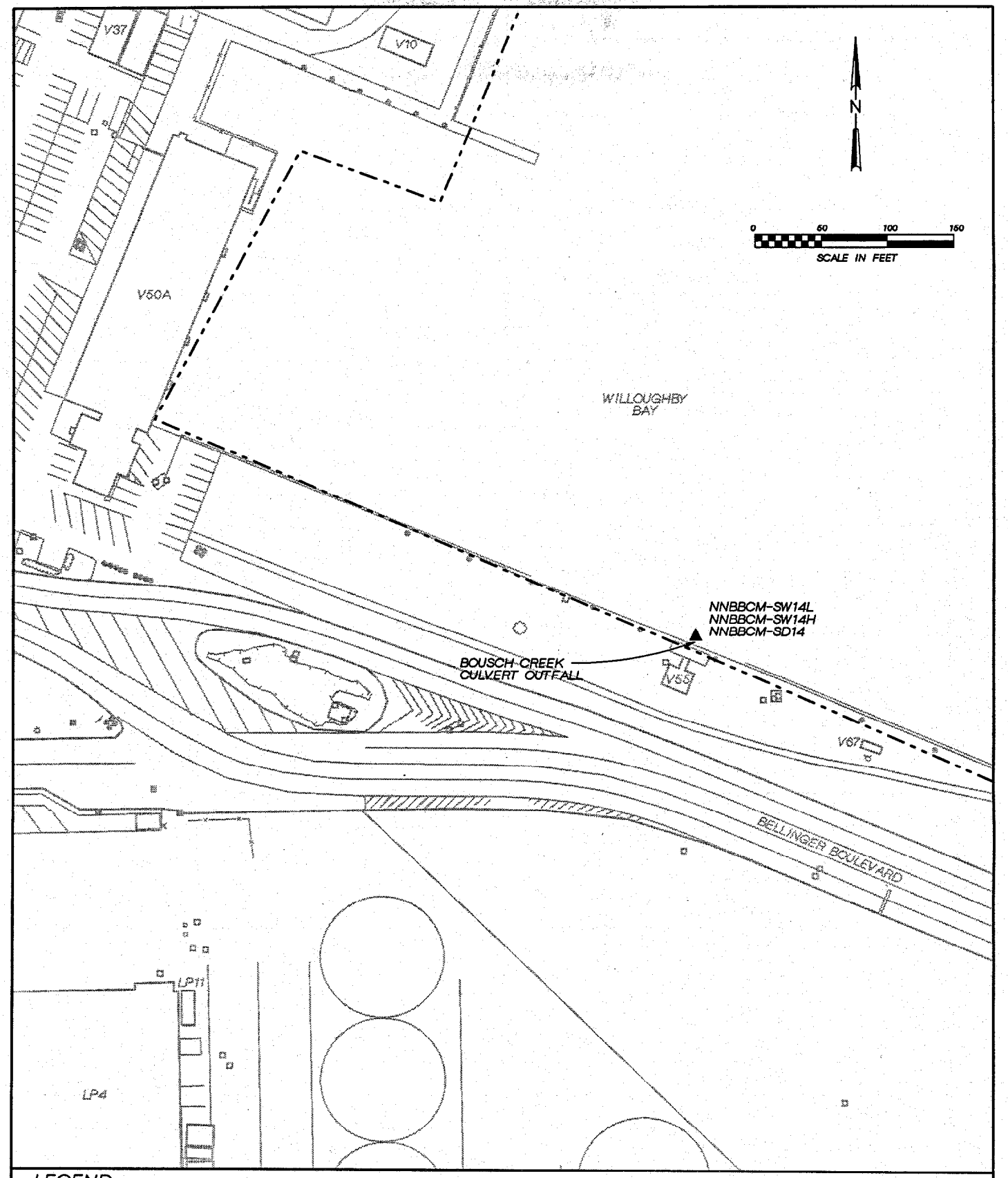

LEGEND

▲	SURFACE WATER QUALITY AND SEDIMENT SAMPLING LOCATION
SW H	SURFACE WATER - HIGH TIDE
SW L	SURFACE WATER - LOW TIDE
SD	SEDIMENT
— - — - —	PROPERTY BOUNDARY - NORFOLK NAVAL BASE

Figure 4-2
PROPOSED SURFACE WATER QUALITY AND SEDIMENT SAMPLING LOCATIONS
Norfolk Naval Base

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Table 4-1
SOIL AND SEDIMENT SAMPLING PROGRAM FOR POST REMEDIATION ECOLOGICAL MONITORING
CAMP ALLEN LANDFILL

Site	Sampling Location	Low Level Volatiles OLC02 Hardness	TCL VOC	TCL SVOC	TCL Pest/PCB	TAL Metals and Cyanide (total)	Total Organic Carbon (TOC)	Grain Size
Bousch Creek	NNBBCM-SW01L	X		X	X	X		
Bousch Creek	NNBBCM-SW01H	X		X	X	X		
Bousch Creek	NNBBCM-SW02L	X		X	X	X		
Bousch Creek	NNBBCM-SW02H	X		X	X	X		
Bousch Creek	NNBBCM-SW03L	X		X	X	X		
Bousch Creek	NNBBCM-SW03H	X		X	X	X		
Bousch Creek	NNBBCM-SW04L	X		X	X	X		
Bousch Creek	NNBBCM-SW04H	X		X	X	X		
Bousch Creek	NNBBCM-SW05L	X		X	X	X		
Bousch Creek	NNBBCM-SW05H	X		X	X	X		
Bousch Creek	NNBBCM-SW06L	X		X	X	X		
Bousch Creek	NNBBCM-SW06H	X		X	X	X		
Bousch Creek	NNBBCM-SW07L	X		X	X	X		
Bousch Creek	NNBBCM-SW07H	X		X	X	X		
Bousch Creek	NNBBCM-SW08L	X		X	X	X		
Bousch Creek	NNBBCM-SW08H	X		X	X	X		
Bousch Creek	NNBBCM-SW09L	X		X	X	X		
Bousch Creek	NNBBCM-SW09H	X		X	X	X		
Bousch Creek	NNBBCM-SW10L	X		X	X	X		
Bousch Creek	NNBBCM-SW10H	X		X	X	X		
Bousch Creek	NNBBCM-SW11L	X		X	X	X		
Bousch Creek	NNBBCM-SW11H	X		X	X	X		
Bousch Creek	NNBBCM-SW12L	X		X	X	X		
Bousch Creek	NNBBCM-SW12H	X		X	X	X		
Bousch Creek	NNBBCM-SW13L	X		X	X	X		
Bousch Creek	NNBBCM-SW13H	X		X	X	X		
Bousch Creek	NNBBCM-SW14L	X		X	X	X		
Bousch Creek	NNBBCM-SW14H	X		X	X	X		
Bousch Creek	NNBBCM-SD01		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD02		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD03		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD04		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD05		X	X	X	X	X	X

Table 4-1
SOIL AND SEDIMENT SAMPLING PROGRAM FOR POST REMEDIATION ECOLOGICAL MONITORING
CAMP ALLEN LANDFILL

Site	Sampling Location	Low Level Volatiles OLC02 Hardness	TCL VOC	TCL SVOC	TCL Pest/PCB	TAL Metals and Cyanide (total)	Total Organic Carbon (TOC)	Grain Size
Bousch Creek	NNBBCM-SD06		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD07		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD08		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD09		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD10		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD11		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD12		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD13		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD14		X	X	X	X	X	X

collected and specific analyses performed are tabulated in Table 4-1. Figures 4-1 and 4-2 provide the locations of the sediment samples listed in Table 4-1.

Surface Water Sampling Techniques

Water depth will determine the type of surface water sampling equipment to be used at each location. Some upstream locations may be sufficiently shallow so that field personnel in waders could collect surface water samples using a direct method of placing a bottle in the stream. At high tide at other locations a small boat will be used, and samples will be collected at mid-depth using a Van Dorn Sampler. Water levels will be determined using a metered lead line.

Surface water samples will be collected at locations (generally less than two feet deep) by submersing the sampling container directly into the surface water body. Care will be taken to ensure that the body of the sampling container is facing downstream so that any sediment disturbed during the immersion of the container does not enter the sampling vessel. If the volume of surface water encountered is insufficient to allow the direct submersion of the sampling containers, a glass interim vessel will be used to transfer the surface water sample to the sample containers. The glass interim vessel will be laboratory-cleaned to the same specifications as the sample containers.

At locations where water depths exceed a depth of two feet, a Van Dorn bottle will be used. The bottle is lowered to the desired depth (i.e., mid-way in the water column) and triggered by a messenger. The rubber ends of the bottle close and the bottle is retrieved and sample containers filled through a sampling port on the bottom of the bottle.

Samples will be placed in containers and analyzed within the proper holding time according to Navy Level D protocol. For volatile organic analysis (VOA) the bottles will be filled so as to minimize aeration of the samples. During the collection of surface water samples, care will be taken to ensure that the pre-added preservative is not rinsed from the sampling container during sample collection. Sample vials will be filled completely and capped to prevent the entrapment of any air bubbles in the vial.

The bottle cap should be removed carefully from the laboratory-cleaned sample bottle. The cap should not be laid down nor the inside touched. At no time should the inside of the bottle come into contact with anything other than the sample.

All appropriate preservatives will be added to the sample containers by the contracted laboratory before shipment to the CH2M HILL field team. VOA samples will be preserved with hydrochloric acid (HCl), TAL metals samples will be preserved with nitric acid (HNO_3), and cyanide samples will be preserved with sodium hydroxide (NaOH). Semivolatiles, pesticides, and PCBs do not require chemical preservatives. Dissolved metals samples will be filtered. All samples will be kept cool at 4°C, using bagged ice. Table 2-1 in the SAP presents details on the containers, preservatives, and holding times for surface water samples.

Sediment Sampling

The initial sediment sampling activity will include an assessment of sample methods because the physical characteristics of the Bousch Creek sediments are unknown. This assessment will include testing both a coring device and a grab sampling device to assess material retrieval. If sediment characteristics are sufficient for retaining the material, the

coring device will be used at each station. If the sediments at sample locations are too coarse to be retained by the coring device, the grab sampler will be used at each station. The objective is to use a uniform sampling methodology at each station to the extent possible. The only station anticipated to require a grab sampler, is the Willoughby Bay outfall station (Figure 4-2), where water depths are expected to be greater than 20 feet. Samples will be collected by field personnel using waders or from a small boat, depending on water depth. The preferred method is a coring device, which uses a polyvinyl chloride (PVC) core, pushed into the sediment not to exceed a depth of one foot, that is capped to ensure suction. After the tube is capped, it will be withdrawn from the bottom with sediment intact. The bottom section of the PVC tube used for sampling will be detachable and discardable to minimize the time required for decontamination measures in the field along with the volume of waste fluids generated from decontamination. Only the top 10 centimeters will be used for analytical testing.

A Ponar Dredge (grab sampling device) may be used as a backup to collect sediment samples, especially at the outfall in Willoughby Bay where water depths are too great to use a PVC tube and where sediments are too coarse to be held in the tube. The ponar dredge is a "clamshell" type sampling device consisting of the bucket/jaws and the sampler arms. During sampling activities, a length of rope is attached to a ring on the top of the sampler arms. The sampler arms are then pushed towards the bucket to open the sampler jaws. The jaws are locked in the open position by inserting a spring-loaded steel pin through a small hole in the arms. The sampler is lifted by the rope, with the samplers weight creating the tension which holds the locking pin in place. The sampler is lowered until the sediments are encountered, pulled up approximately 6-inches, and allowed to free fall. With the tension relieved, the spring on the locking pin forces the pin out of the hole in the arms. As the sampler is retrieved, the jaws close trapping the sediment sample inside. Any surface water entrapped in the sampler is slowly decanted through a screened port on the top of the ponar.

Sediment Handling

The VOC sample containers will be filled first. The upper 10 centimeters of the sample will be sliced and placed directly into the VOC sample container to minimize the volatilization of organic compounds. The top 10 centimeters from samples at the same location will be sliced and placed into a stainless steel bowl and mixed thoroughly. After mixing, all other sample containers will be filled.

All samples will be placed in clean glass containers provided by the laboratory. Any sample that is split for duplicate analysis will be mixed thoroughly before being split (except for VOCs).

Surveying

A subcontracted surveyor licensed in the State of Virginia will determine horizontal coordinates for the surface water and sediment sampling locations. All surface water and sediment sampling points will be located using state plane coordinates with vertical elevations referenced to United States (USGS) vertical datum. Sample data and vertical and horizontal locations will also be provided on magnetic media. Survey stakes will be driven into bottom sediments to mark sample locations because samples will be collected from the center of a tidal creek. High and low tide elevations will be marked on the stakes. The

surveyors will determine horizontal and vertical datum from these stakes. Where necessary, the survey contractor shall convert the base sea-level datum to the USGS msl datum.

Sample Analysis and Data Validation

CH2M HILL will be responsible for tracking sample analyses and obtaining results from the laboratory. The analytical data generated during the ecological monitoring field program will be validated by an independent data validation subcontractor according to the U.S. EPA Contract Laboratory Program National Functional Guidelines for Data Review (organic and inorganic).

Sample Analysis

All analyses of surface water and sediment will be conducted at a contracted laboratory that fulfills all requirements of the U.S. Navy's QA/QC Program Manual and EPA's CLP. A signed certificate of analysis will be provided with each laboratory analysis, along with a certificate of compliance certifying that all work was performed in accordance with the applicable federal, state, and local regulations. All analyses will be performed following Navy guidance for Level D.

Field Quality Control Procedures

Quality control duplicate samples and blanks are used to provide a measure of the internal consistency of the samples and to provide an estimate of the components of variance and the bias in the analytical process. Table 10-1 in the QAPP provides a summary of the collection frequencies of the field QC samples.

Blanks

Blanks provide a measure of cross-contamination sources, decontamination efficiency, and other potential errors that can be introduced from sources other than the sample. American Society of Testing Materials (ASTM) Type II water will be used for blanks. Three types of blanks will be generated during sampling activities: trip blanks, field blanks, and equipment blanks.

One trip blank will be included in each cooler containing samples for VOC analysis. Pre-prepared trip blanks will be obtained from the laboratory, if possible. Otherwise, the trip blanks will be prepared prior to each sampling event, shipped or transported to the field with the sampling bottles, and sent to the laboratory unopened for analysis. Trip blanks will not be prepared or handled in the field. Trip blanks will indicate if any contamination occurred during shipment to the field, field storage, or during shipment from the field to the analytical laboratory.

One field blank will be collected each week of sampling. The field blanks will indicate if any contaminants were introduced during the handling of the sample containers in the field or during sample analysis at the laboratory. The sample container will be filled with ASTM Type II water in the field at the time of sampling. Pre-preserved bottles will be obtained from the laboratory, if possible; otherwise, preservatives will be added in the field. Field blank sample containers will be capped, packed, and shipped with the samples.

One equipment blank will be collected and analyzed every day during sampling activities. The equipment blanks will indicate the efficiency of equipment decontamination procedures. Pre-preserved bottles will be obtained from the laboratory, if possible; otherwise, preservatives will be added in the field. Field blank sample containers will be capped, packed, and shipped with the samples.

Duplicates

Field duplicate samples will be collected at a frequency of 1 per 10 field samples per matrix. The location from which the duplicates are taken will be randomly selected. The duplicate sample will be submitted for analysis as an independent sample. The sample and its duplicate will be numbered non-sequentially.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Matrix spike/matrix spike duplicate (MS/MSD) samples will be collected at a frequency of 1 per 20 field samples. Analytical results of these samples indicate the impact the matrix (surface water or sediment) has on extracting the analyte for analysis. Data validators will use these results to evaluate the accuracy of the analytical data.

Data Validation

All data will be validated before the project staff performs an interpretation. The data validation will be performed by an independent subcontractor, and will conform to the Navy guidance for Level D. Data that should be qualified will be flagged with the appropriate qualifier according to the functional guidelines. Results for QA/QC samples will be reviewed and the data will be qualified further, if necessary. Finally the data set as a whole will be examined for consistency, anomalous results, and reasonableness.

Task 3: Data Review

The purpose of the task is to establish the fate and transport of pollutants discharged in the Bousch Creek watershed in the vicinity of the Camp Allen Landfill. The Bousch Creek watershed is a complex, tidally influenced watershed. Salinity and tidal fluctuations can influence the near and far field fate and transport of contaminants within a tidal system, especially for a watershed that has multiple discharges that may alter surface water chemistry.

The first activity under this task will be a review of existing hydrological data for the Bousch Creek watershed. This review will include the compilation of available data from permitted discharges, nonpermitted discharges, tidal studies, stormwater investigations, and previous Willoughby Bay investigations.

CH2M HILL will compile and qualitatively describe other sources of runoff or point source discharges within the 1.7 mile stretch of Bousch Creek in the vicinity of CAL. These other sources include additional Navy sources, along with non-Navy commercial businesses and private housing. CH2M HILL will collect monthly permitted discharge reports from the base environmental compliance staff for discharges to Bousch Creek and the confluence of Bousch Creek with Willoughby Bay.

A literature search also will be performed of other permitted discharges by contacting Virginia DEQ for characterizing these surface water features and their contaminants. The data from both Navy and non-Navy permitted discharges will be evaluated and summarized to describe the nature of contamination in Bousch Creek and Willoughby Bay with respect to CAL.

The second component of this task is the compilation of available data on historical dredging operations that shaped the present day base conditions at the confluence of the James River, Elizabeth River and Willoughby Bay. In addition, the history of Bousch Creek channel relocation will be researched. CH2M HILL will contact appropriate federal and state agencies, public libraries, and environmental groups (e.g., Chesapeake Bay Commission, Elizabeth River Commission) for this additional information, which will be incorporated into the revised ERA. Appropriate sediment quality data will be collected and reviewed to aid in characterizing sediment quality, especially for reference locations. The most upstream sample locations (i.e., NNBBCM-SD08, NNBBCM-SD09, NNBBCM-SD10, and NNBBCM-SD11) are assumed to represent potential sediment reference locations for this ecological risk assessment.

Task 4: Hydrological Studies

Overview

In support of the preparation of a revised ERA for Bousch Creek, the flow regime and tidal influences of the creek will be characterized in the vicinity of Camp Allen. Flow depth and velocity measurements will be taken at four (4) locations in Bousch Creek. Three of these locations will be near the Camp Allen Landfill and one will be located at the Bousch Creek outfall into Willoughby Bay. Data will be collected for a period of approximately four days.

An area-depth relationship will be developed to translate field measurements of depth and velocity into flow. Tidal fluctuations will be recorded to determine the extent and duration of the tidal influence on the watershed. The tidal fluctuations will be correlated with data collected from the National Oceanic and Atmospheric Administration (NOAA) gauges at Hampton Roads (Sewell's Point) and Norfolk. Meteorological information will be collected from the National Weather Service (NWS) station at the Norfolk International Airport to relate any storm events that occur during the monitoring period to the flow and tidal observations. Data from the rain gauge at Naval Base, Norfolk, also will be used if there is a precipitation event during the hydrological studies.

Field Procedures

Equipment required to set up the four monitoring stations will be collected. A field team of two people will visit the proposed monitoring sites to determine the most appropriate monitoring site within the selected range for each monitoring location. The field team will install the equipment and take physical measurements at each site. Four days later, a field team will return to each site to take additional physical measurements, download the data, and disassemble the equipment. Each of these steps is further described in this section.

Equipment Requirements

Five sets of equipment will be prepared. One probe will be used at each of the 4 sites. If one of the four sites has a relatively wide and varying cross-section, the fifth set of equipment will be used there. Installing two probes at different locations across a varying cross-section will allow for a more accurate analysis than one probe. The site with two meters, if any, will be selected in the field.

At a minimum, the field team will take the following equipment into the field:

- Flow meters (including depth and bi-directional velocity probes, ISCO Model 4250 flow meter or equivalent), (5)
- 12 Volt Marine batteries for power supply (5)
- Hand held velocity probe for equipment calibration (1)
- Sections of PVC pipe (at least 5)
- Wooden posts or stakes to attach the PVC pipe to (5)
- Hardware (e.g., hammer, nails, cords)
- Survey rod for cross-section measurements
- Rain gauge
- Camera
- Personal safety equipment (including waders)
- Boat, if needed (rental 15-foot boat with outboard motor)

Site Assessment and Selection

Near the CAL, Bousch Creek has 2 branches: one to the east and north of the CAL, and one that starts on the south of the CAL and then runs along the west side. The confluence of these branches is on the northern side of the CAL. Several hundred feet downstream of this confluence, Bousch Creek enters a culvert system which runs approximately 3,500 feet northeast to the creek's outfall to Willoughby Bay.

Four monitoring areas have been selected in order to characterize the flow regime and tidal influences in Bousch Creek. These 4 areas are:

1. Bousch Creek outfall to Willoughby Bay
2. Just downstream of the confluence of the two branches
3. Just upstream of the confluence on the western branch.
4. Near the headwaters of the western branch.

Data from the outfall and headwaters locations will provide information about the ends of the system. A combination of data from locations 2 and 3 will provide information about the relative contributions from the two creek branches. The western branch was selected for sampling locations 3 and 4 rather than the eastern branch because its drainage area is larger and therefore it is less likely to dry up during low tide in a dry period.

The field team will perform a field reconnaissance at the four selected sampling areas to determine the exact monitoring locations. The following factors will be used to evaluate monitoring sites:

- **Channel cross-section.** More uniformity of the cross-section increases reliability of the stage-area curve for each location.
- **Appropriate location to install equipment.** Some type of structure is required for the probe attachment and a secure location is required to install the data logger.
- **Accessibility.** The selected location should be readily accessible from a roadway or by boat. The location should be accessible by wading, if possible during low tide.
- **Electrical connection.** Access to an electrical source is preferred, but not necessary. If it is not available, care must be taken in positioning the marine battery to protect it from the weather.
- **Safety.** The site should not have any constraints to implementing appropriate safety protocols.

Field Data Collection During Installation

Several types of data will be collected during the initial site visit. Preliminary cross-sectional data will be collected at several places near each site as part of the site assessment discussed above.

After each specific site is located, a stake will be installed. The probes will be attached to this stake. A reference elevation mark will be placed on the stake and up to 10 cross-sectional elevation points will be tied to this reference point. A survey crew will then determine the elevation and horizontal position of this reference point based on known, local benchmark locations. This data will provide the cross-sectional area data for the stage-area curve as well as the elevation differences between the sampling locations.

The probes will also be calibrated in the field by taking instantaneous depth and velocity measurements. In addition, at least one vertical velocity profile will be developed at each site. A rain gauge will be installed at one of the sites to supplement the rain data that will be collected from the NWS station at the airport. Finally, field notes will be taken regarding the site conditions, noting any debris or other barriers to free flow, color or odor observations, bank materials, and any existing erosion problems.

Demobilization/Equipment Removal

At the end of the monitoring period, the data will be downloaded from the data logger to a computer in a spreadsheet format and briefly reviewed in the field. The level in the rain gauge will also be recorded. Once it is confirmed that the monitors collected the data and that the downloading was successful, all flow monitors and the rain gauge will be removed and the sites will be restored to their original condition.

Safety

The field team will follow CH2M HILL's HASP that establishes safety practices and procedures for all employees.

Data Analysis

All data will be recorded in 5 minute increments. All depth and velocity data recorded by the gauge will be downloaded to a computer in a spreadsheet format, reviewed and processed. Pertinent information from field notes, including manual depth and velocity calibration measurements, velocity profile measurements, silt levels, visual observation, and special notes will be taken into account when reviewing and processing the recorded field data.

Stage-area relationships will be developed for each flow monitoring site. The cross-sectional areas will incorporate debris levels, if applicable. The cross sectional area information will be stored in depth vs. area tables. Flow rates will be calculated from the recorded field data using the continuity equation, flow equals velocity times the cross-sectional area (Q=VA).

All recorded data and corresponding calculated flow rates will be compiled in a table with the following columns of data, at a minimum:

- Date and Time
- Calibrated Depth (feet)
- Calibrated Velocity (feet per second)
- Computed Flow (cubic feet per second)

Flow versus time plots and depth versus area tables will be provided for each flow monitoring site. A log of site visits will be kept describing findings, calibration procedures, and any monitor or sensor relocations.

Rainfall data for the monitoring period will be compiled in a spreadsheet.

Task 5: Ecological Risk Assessment

The data gathered from Tasks 2, 3, and 4 will be incorporated into a stand-alone, revised Ecological Risk Assessment Report. A draft, draft-Final, and Final report will be prepared. The surface water and sediment data will be analyzed in accordance with EPA Region III guidance for conducting ERAs and using screening levels. The analysis will identify potential aquatic receptors in the Bousch Creek watershed in the revised ERA. The Environmental Effects Quotient (EEQ) will be calculated for each parameter that has criteria in each sample, and a summation of Ecological Chemicals of Concern (ECOC) as they apply to the identified receptors will be presented. The results of the literature and data review will be used for formulating potential reference, or background, locations for the purposes of comparing data between sampling locations. The suitability of upstream sampling locations as depicted on Figure 4-2 (i.e., NNBBCM-SD08, NNBBCM-SD09, NNBBCM-SD10, and NNBBCM-SD11) as reference locations also will be addressed.

From the literature reviewed, potential aquatic receptors will be identified. NOAA, the U.S. Fish and Wildlife Service (FWS) and the Virginia Natural Heritage Office will be contacted regarding the potential for endangered and threatened species to occur in the area.

Summary ecotoxicological profiles will be provided, based on existing databases and searches, for the ECOC determined for the site, including reproductive and growth effect

endpoints. Potential risk will be characterized based on EEQ values (e.g., EEQ of 1 to 10 demonstrates a potential risk; EEQ from >10 to 100 is considered a moderately high potential risk; and EEQ >100 considered an extreme risk). The potential for bioaccumulation will be discussed qualitatively. Various assumptions and exposure parameters will be discussed in the context of an uncertainty analysis. The potential for risk will be discussed relative to other point and non-point sources in the watershed.

If warranted, the report will provide recommendations for additional actions will be provided.

Section 5

Staff Organization

This section presents general information regarding project management and staff organization.

Project Management

Project Management will include the overall coordination of all work to be performed for the post-remediation ecological monitoring at CAL. The management structure for CH2M HILL is designed such that there is one central administrative point of contact, the Activity Manager, and multiple technical Project Managers who will manage each technical task as their expertise is required. The Activity Manager will maintain close contact with the LANTDIV NTR.

The Activity Manager will oversee and coordinate each project to maintain the overall project schedule and coordinate the Monthly Progress Report effort. In addition, the Activity Manager and the Technical Project Managers will conduct weekly internal program review meetings to update all team members on individual project status and upcoming technical needs and to discuss technical issues that might impact the course, and/or completion of other technical tasks. Subsequent to the weekly internal review meetings the Activity Manager will relay pertinent issues to the LANTDIV NTR. The Activity Manager also will provide general program support, interaction with client and regulatory agencies, and documentation of decisions on technical issues that might affect future work at the Base.

Responsibilities for the Technical Project Managers include such activities as daily technical support and oversight, budget and schedule review and tracking, preparation and review of invoices, personnel resource planning and allocation, and project-specific coordination with LANTDIV, the Activity, and subcontractors.

Project-Specific Organization

The Activity Manager, Mr. Michael Tilchin, will serve as the primary point of contact for the project, and will provide guidance to the Project Manager. The Project Manager for CTO-0011, Mr. Paul Nikituk, will be responsible for such activities as budget and schedule review and tracking, preparation and review of invoices, personnel resources planning and allocation, and coordination with LANTDIV, the Base, and subcontractors. The field investigation tasks will be performed by supporting field personnel. In addition, Mr. Doug Dronfield, Dr. Robert Root, and Dr. Jamie Maughan will provide senior review during the project. The project organizational chart is depicted in Figure 5-1.

CH2M HILL will notify LANTDIV and the Base regarding which CH2M HILL personnel will mobilize to the site prior to initiating field activities. CH2M HILL also will notify the appropriate Base personnel to acquire site access. The LANTDIV NTR, Mr. Dave Forsythe,

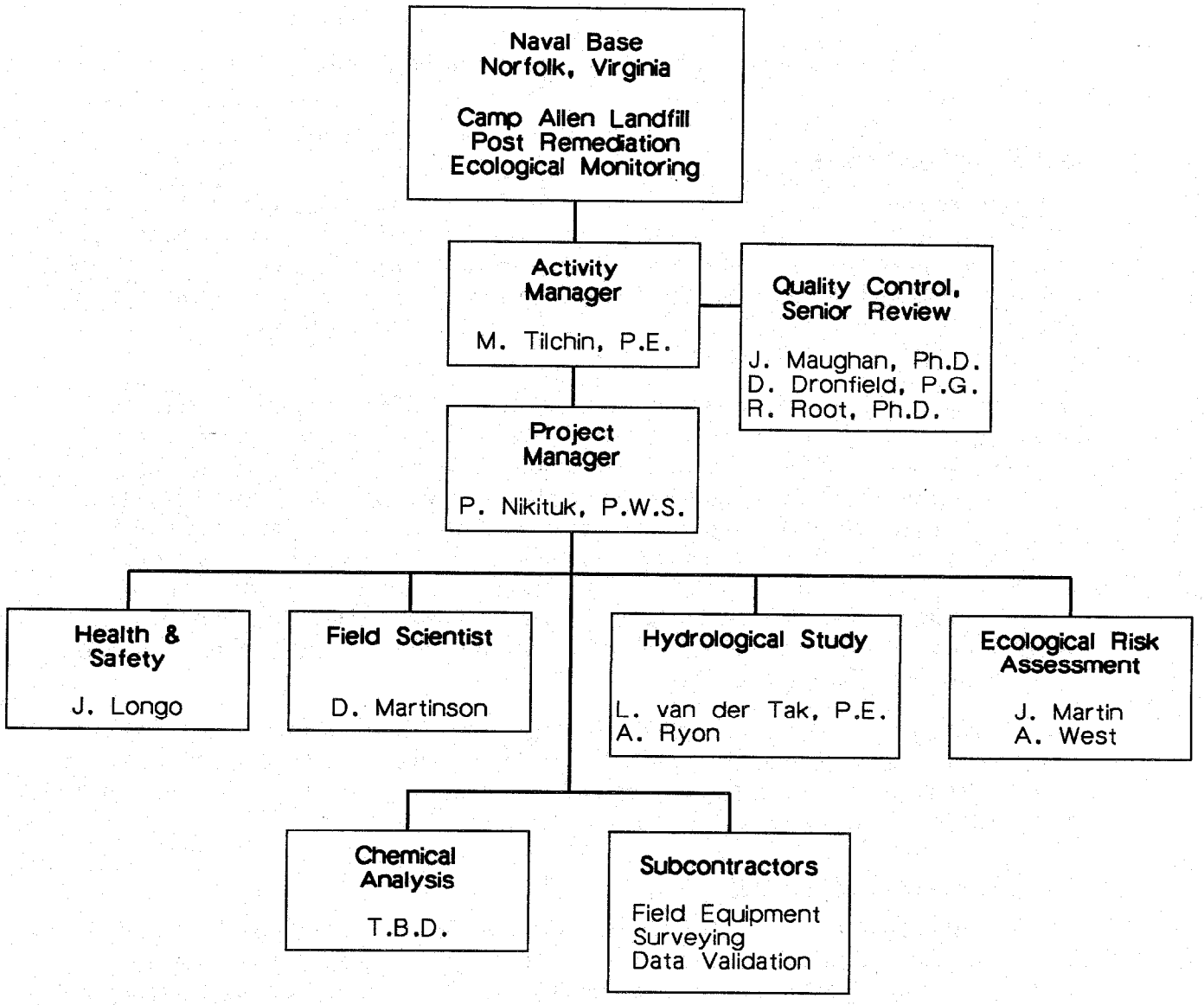

Figure 5-1
PROJECT ORGANIZATION
ECOLOGICAL MONITORING
Naval Base, Norfolk

CH2MHILL

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and the Com. Nav. Base Engineer in Charge, Ms. Diane Bailey, will be advised of all site activities and schedules prior to site operations. Naval Base, Norfolk, contacts are tabulated below in Table 5-1.

Table 5-1
Naval Base, Norfolk Contact List

Contact Person	Responsibility	Department	Phone Number	Fax Number	Location on Base
Mr. Dave Forsythe	Environmental Engineer and NTR	Installation Restoration Section, LANTDIV	804-322-4783	804-322-4805	1510 Gilbert Street Norfolk, VA 23511-2699
Ms. Diane Bailey	Engineer in Charge, Com. Nav. Base	Norfolk Naval Base Environmental	804-322-2900	804-444-3000	Suite 200 1520 Gilbert Street Norfolk, VA 23511-2979
Mr. Roger Hillers (or Mr. Rusty Carter)	Water, steam, sewage, electrical, and natural gas lines	Public Works	804-224-8558	804-445-9316	Building P71 9742 Maryland Ave. Norfolk, VA 23511-3095
Mr. Meryl Kauffman	Digging permits	Public Works	804-224-8558	804-445-9316	Building P71 9742 Maryland Ave. Norfolk, VA 23511-3095
Mr. Gonzalez	Fuel lines	Naval Base Fuel Department	804-444-3450	804-444-7333	On waterfront across from Pier 5
Mr. Romeo Santodomingo	Fuel lines	NAS Fuel Department	804-444-2625		
Mr. Jerry Fly	Communications lines	Communications	804-322-2045 804-475-6090 (Beeper)	804-445-6803	Building M51, Room 149
Mr. Paul Kidd	Survey monumentation	Code 405 (Civil/Survey)	804-322-4405	804-322-4415	Building N26, 3rd Floor

Note: The base phone numbers are in the process of being changed from 444- and 445- prefixes to a 322- prefix

Section 6

Contractual Services

This section documents the anticipated subcontract services required for the completion of tasks documented in this Work Plan. CH2M HILL is in the process of acquiring Basic Order Agreements (BOAs) with existing Navy CLEAN subcontractors used under the CLEAN I contract. BOAs will be negotiated with new subcontractors on an as needed basis.

The ecological monitoring task will require subcontract services from the following:

- Surveyor
- Analytical Laboratory
- Data Validation
- Equipment Supplier

Section 7

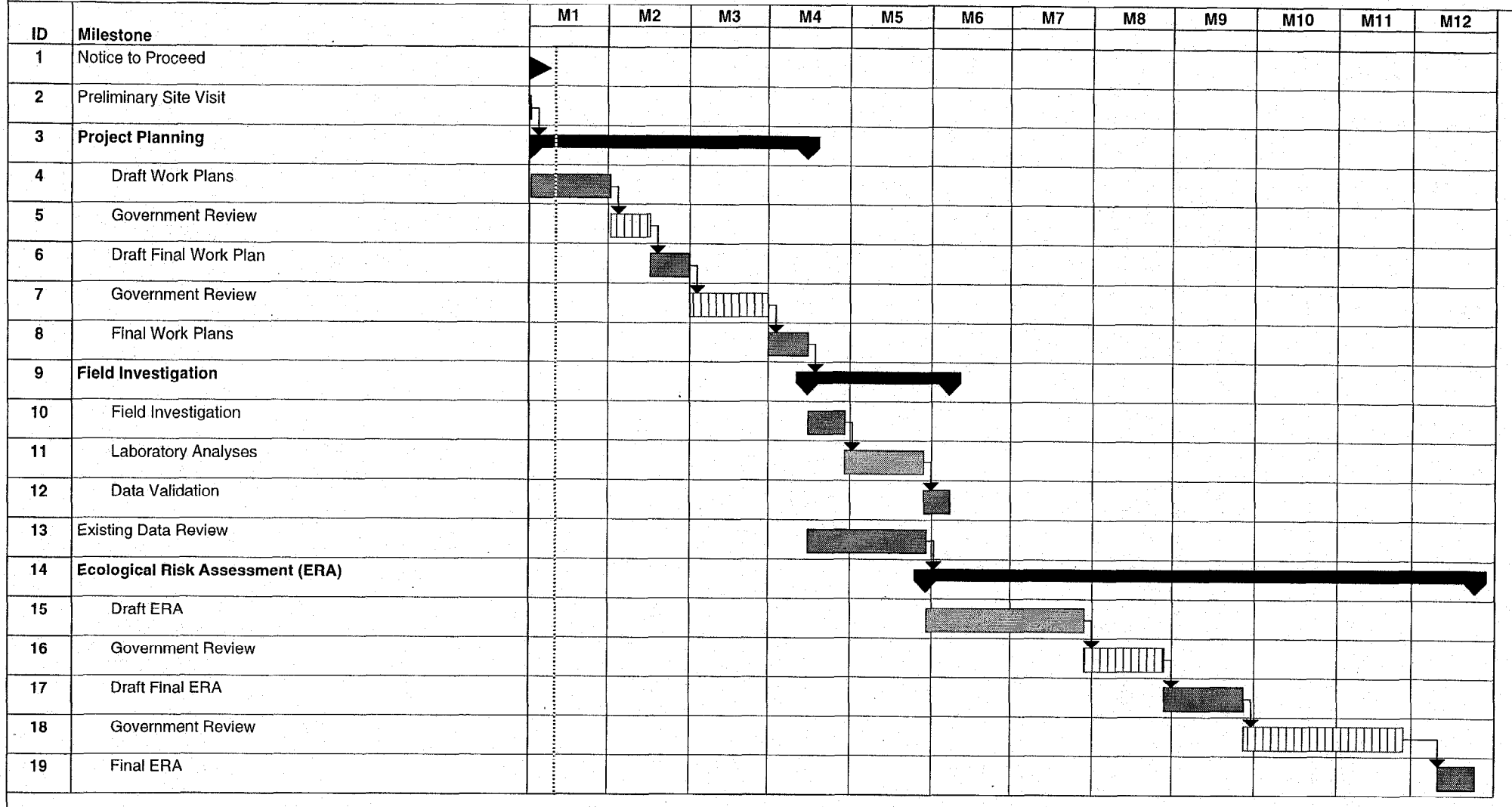
Schedule

This section documents the project schedule and the due dates of deliverables.

This project will be performed in accordance with the schedule and milestones presented in Figure 7-1. Table 7-1 shows a breakdown of primary task deliverables, and milestones with their respective due dates. Government review periods also are tabulated. Longer periods of review will result in an extended schedule.

WDCR1014/013.DOC

FIGURE 7-1
SCHEDULE
CTO-0011 - CAMP ALLEN LANDFILL ECOLOGICAL MONITORING



Project: CTO-0011 - CAMP ALLEN LANDFILL ECOLOGICAL MONITORING
NAVAL BASE, NORFOLK
DATE: 4/11/96

Government Review
Task
Summary
Milestone
Note: Timescale is in months from NTP

Table 7-1
Project Milestones
Camp Allen Landfill
Post Remediation Ecological Monitoring
CTO-0011

Key Project Milestones	No. of Days from Award	Interval
Draft Work Plan	30	30
LANTDIV Review	45	15
Draft Final Work Plan	60	15
LANTDIV Review	90	30
Final Work Plan	105	15
Draft Ecological Risk Assessment	225	120
LANTDIV Review	255	30
Draft Final Ecological Risk Assessment	285	30
Government Review	345	60
Final Ecological Risk Assessment	360	15

WDCR1014/015.DOC

Draft Final

Sampling and Analysis Plan for the Post Remediation Ecological Monitoring Camp Allen Landfill

Norfolk Naval Base
Norfolk, Virginia

Prepared for

Department of the Navy
Atlantic Division
Naval Facilities Engineering Command

Contract No. N62470-95-D-6007
CTO-0011

August 1996

Prepared by

CH2M HILL
Federal Group, Ltd.
Herndon, Virginia

Preface

This Sampling and Analysis Plan (SAP) is written for the Post Remedial Ecological Monitoring to be performed at the Camp Allen Landfill at the Naval Base, Norfolk, Virginia. Specifically, this SAP focuses on the activities associated with surface water and sediment sampling. The SAP is comprised of four separate plans.

1. The Quality Assurance Project Plan (QAPP)—The QAPP describes the policy, organization, functional activities, and quality assurance and quality control protocols necessary to achieve Data Quality Objectives (DQOs) as dictated by the intended use of the data.

2. The Field Sampling Plan (FSP)—The FSP provides guidance for all fieldwork by defining in detail the sampling and data-gathering methods to be used during field activities.

3. The Health and Safety Plan (HASP)—The HASP describes CH2M HILL's health and safety program for field activities. The HASP identifies potentially hazardous operations and exposures and prescribes appropriate protective measures.

4. The Investigation-Derived Waste Management Plan (IDWMP)—The IDWMP provides guidance and assigns responsibility for the disposal of investigation-derived waste (IDW). The IDWMP describes both well-site disposal and containerization and temporary storage of certain IDW.

133236.PM.PO/D1/11/wdc.dlw

Draft Final

Quality Assurance Project Plan for the Post Remediation Ecological Monitoring Camp Allen Landfill

Norfolk Naval Base
Norfolk, Virginia

Prepared for

Department of the Navy
Atlantic Division
Naval Facilities Engineering Command

Contract No. N62470-95-D-6007
CTO-0011

August 1996

Prepared by

CH2M HILL
Federal Group, Ltd.
Herndon, Virginia

Contents

Contents (continued)

Tables **Page**

Figures

Acronyms and Abbreviations

CLP	Contract Laboratory Program
CofC	Chain-of-Custody
DO	Dissolved oxygen
DQOs	Data Quality Objectives
EPA	Environmental Protection Agency
FSP	Field Sampling Plan
HASP	Health and Safety Plan
LANTDIV	U.S. Navy Naval Facilities Engineering Command, Atlantic Division
LQAP	Laboratory Quality Assurance Plan
MS	Matrix Spike
MSD	Matrix Spike Duplicate
µg/l	Micrograms per liter
NFESC	Navy Facilities Engineering Services Command
OLC02	EPA analytical method for Organic Low Concentration Water
%R	Percent Recovery
PCB	Polychlorinated biphenyl
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RPD	Relative Percent Difference
RPM	Remedial Project Manager
RSD	Relative Standard Deviation
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
SOW	Statement of Work
SVOCs	Semivolatile Organic Compounds
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TCL	Target Compound List
VOCs	Volatile Organic Compounds

SECTION 1

Introduction

This plan describes the Quality Assurance and Quality Control (QA/QC) procedures to be used for conducting sediment and surface water sampling activities at Camp Allen Landfill at the Norfolk Naval Base, Norfolk, Virginia. The Quality Assurance Project Plan (QAPP) focuses on the sampling activities for the Post-Remediation Ecological Monitoring at the landfill. All field sampling and laboratory analyses will be conducted in accordance with the *Navy Installation Restoration Laboratory Quality Assurance Guide*, February 1996.

SECTION 2

Project Description

Camp Allen Landfill is located to the center and slightly south within the naval base at Norfolk, Virginia. A nearby stream, Bousch Creek, has been significantly altered as the base has developed. The creek includes a network of drainage ditches that surround the landfill, and the surface water and sediment in the ditches are an ecological concern. The water in Bousch Creek is tidally influenced and discharges to Willoughby Bay, and eventually to the Chesapeake Bay.

The work plan for the Post-Remediation Ecological Monitoring provides a more detailed history of the site use and a description of activities to be performed.

The objectives of the sampling work to be performed at Bousch Creek near Camp Allen Landfill are to:

- Collect fourteen sediment samples from selected locations in Bousch Creek to determine if contaminants found at the Camp Allen Landfill are present in the creek. The proposed sampling locations are shown in Figures 1-1 and 1-2 of the Field Sampling Plan (FSP).
- Collect twenty-eight surface water samples (fourteen samples will be collected during low tide, and the remaining fourteen samples will be collected during high tide conditions) from the same locations designated for the sediment samples.
- Analyze all sediment samples for EPA's Target Compound List (TCL) organics (volatiles, semivolatiles, pesticide/PCBs) and Target Analyte List (TAL) inorganics (metals and cyanide). Aqueous samples will be analyzed for TCL semivolatiles and pesticide/PCBs and TAL inorganics. The volatile fraction of the surface water samples will be analyzed by EPA's Contract Laboratory Program (CLP) Statement of Work (SOW) for Low Concentration Water (OLC02) in order to achieve the lower detection limits necessary for risk assessment. The compound list is found in Table 1-1 of the FSP. All analytical results to be used in the ecological risk assessment will require Navy Level D QA/QC.
- Use the validated analytical data to revise the existing Ecological Risk Assessment (ERA) and to calculate ecological risks.
- Collect data on current depth and velocity at three locations in Bousch Creek and one at the confluence of Bousch Creek with Willoughby Bay to determine flow.

SECTION 3

Project Organization

Mr. Michael Tilchin will serve as the activity manager and the primary contact at CH2M HILL. Mr. Tilchin will assume primary responsibility for ensuring that the work is performed in a manner that is acceptable to LANTDIV. With the activity manager's oversight, the project manager, Mr. Paul Nikituk, will be responsible for such activities as budget and schedule review and tracking, preparation and review of invoices, personnel resources planning and allocation, and coordination with LANTDIV, the Naval Base, and subcontractors. Mr. Doug Dronfield, Dr. Robert Root, and Dr. Jamie Maughan will provide senior review. Figure 3-1 represents a chart view of the project organization.

The ecological monitoring tasks will be performed by the CH2M HILL supporting field personnel. CH2M HILL will notify LANTDIV and the Naval Base, Norfolk, as to which CH2M HILL personnel will mobilize to the site prior to initiating field activities. A field task manager will be assigned to lead all field activities. This person will be responsible for assuring that the SAP is being followed, maintaining the field log book, monitoring the site for all releases, and other activities. The field staff will be responsible for collecting the samples, completing sample paperwork, shipping samples, and the like.

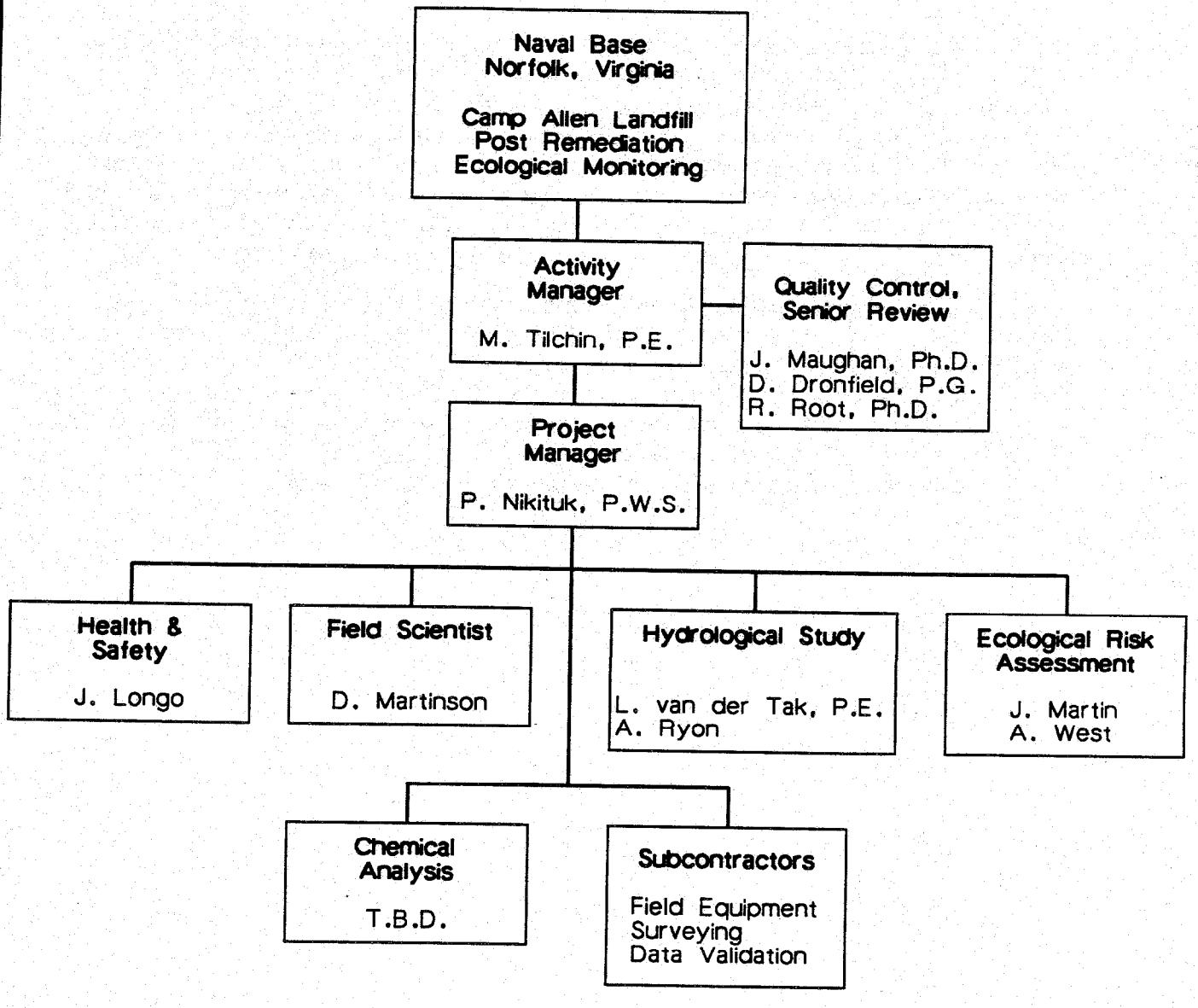


Figure 3-1
PROJECT ORGANIZATION
ECOLOGICAL MONITORING
Naval Base, Norfolk

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SECTION 4

Quality Assurance Objectives

Data Quality Objectives (DQOs) will be established for each major sample collection effort as specified in the *Data Quality Objectives for Remedial Response Activities*, March 1987. DQOs are the quantitative and qualitative descriptions of the quality of data required to support an environmental decision or action. As target values for data quality, they are not necessarily criteria for acceptance or rejection of data. DQOs for a site vary according to the end use of the data. Everyone from the data gatherer to the analytical laboratory is involved in the DQO development process from the beginning.

The fundamental mechanisms that will be employed to achieve quality goals are:

- prevention of errors through planning, documented instructions and procedures, and careful selection and training of personnel
- assessment of data through field and laboratory audits and data validation of the analytical results
- correction of errors through a corrective action program.

The four documents in the SAP (QAPP, FSP, HASP, and IDWMP) contain the plans and procedures for safe, competent sampling and for effective management of the data. Each laboratory providing analytical data for the monitoring at Camp Allen Landfill has developed its own Laboratory Quality Assurance Plan (LQAP). The SAP and the LQAP must address the elements of the Navy QA Program.

Audits in the field and in the laboratories will determine how the QA/QC procedures are being implemented. Any discrepancies will be addressed through the corrective action programs described in the SAP and LQAP.

The detection limits achieved by the EPA's TCL organics and TAL inorganics analyses for sediment are adequate to meet the DQOs for this project. Surface water samples will be analyzed for TCL semivolatiles and pesticide/PCBs and TAL inorganics. The volatile fraction will be analyzed by OLC02 to meet the low detection limit requirements of the ecological risk assessment. Navy D Level data validation for this project will ensure that the data obtained with the EPA protocols will be acceptable.

DQOs are measured by the degree of precision, accuracy, representativeness, completeness, and comparability of the data that is required for the project. The project precision and accuracy objectives for laboratory analysis are included in Table 4-1. The quality objectives for field parameters are included in Appendix A of the FSP (i.e., Standard Operating Procedures for pH, conductivity, dissolved oxygen).

Table 4-1 PRECISION and ACCURACY OBJECTIVES			
Parameter	**Precision (Relative Percent Difference)**	**Accuracy (% Spike Recovery)**	**Intended Data Use**
Surface Water			
TCL Volatiles	< ±20	80-120	Determine extent of contamination; ecological risk assessment
Low Concentration Volatiles	< ±20	80-120	Determine extent of contamination; ecological risk assessment
TCL Semivolatiles	< ±20	80-120	Determine extent of contamination; ecological risk assessment
TCL Pesticides/PCBs	< ±20	80-120	Determine extent of contamination; ecological risk assessment
TAL Metals and Cyanide	< ±20	80-120	Determine extent of contamination; ecological risk assessment
Hardness	< ±30	75-125	Characterize the water quality
Sediment			
TCL Volatiles	< ±25	75-125	Determine extent of contamination; ecological risk assessment
TCL Semivolatiles	< ±25	75-125	Determine extent of contamination; ecological risk assessment
TCL Pesticides/PCBs	< ±25	75-125	Determine extent of contamination; ecological risk assessment
TAL Metals and Cyanide	< ±25	75-125	Determine extent of contamination; ecological risk assessment
Total Organic Carbon	< ±35	70-130	Characterize the sediment quality
Grain Size	< ±35	NA	Characterize the sediment

Accuracy and Precision

Accuracy is a measure of the agreement between an experimental result and the true value of the parameter. Analytical accuracy can be determined using known reference materials or matrix spikes. Spiking of reference materials into the actual sample matrix is the preferred technique because it quantifies the effects of the matrix on the analytical accuracy. Accuracy can be expressed as percent recovery (%R) determined by the following equation:

$$\%R = \frac{SSR - SR}{SA} \times 100$$

where: SSR = spiked sample result
SR = sample result (native)
SA = spike added

Precision is the measure of the agreement or repeatability of a set of duplicate results obtained from repeat determinations made under the same conditions. The precision of a duplicate determination can be expressed as the relative percent difference (RPD) which is determined by the following equation:

$$RPD = \frac{|X1 - X2|}{X1 + X2} \times 200$$

where: X1 = first duplicate value

X2 = second duplicate value

For a given laboratory analysis, the duplicate RPD values are tabulated, and the mean and standard deviation of the RPD are calculated. Control limits for precision are usually plus or minus two standard deviations from the mean.

Accuracy and precision will be monitored by using field duplicate, matrix spike, and matrix spike duplicate samples. These data alone cannot be used to evaluate accuracy and precision of individual samples but will be used to assess the long-term accuracy and precision of the analytical method.

Completeness

Completeness is defined as the percentage of analytical measurements made that are judged to be valid, with validity being defined by the DQOs. Percent completeness is calculated as the number of valid analyses divided by the total number of analyses performed multiplied by 100. The completeness goal for the project is 85 percent.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent parameter variations at a sampling point. Representativeness is a measure of how closely the measured results reflect the actual distribution and concentration of certain chemical compounds in the medium sampled. The FSP describes the procedures to be used to collect samples. This process will generate samples that are as representative as possible. Documentation of laboratory and field procedures, as described in the FSP, will be used to establish that protocols have been followed and that sample identification and integrity have been maintained.

Comparability

Comparability is the term that describes the confidence with which one data set can be compared to another. Comparability refers to such issues as using standard field and analytical techniques, following the same QA/QC procedures, and reporting data in the same units. This criterion becomes important if more than one field team is collecting samples or more than one laboratory is analyzing the samples. Consistency in sampling

and laboratory procedures will be maintained throughout the project. (See the FSP for a discussion of sampling procedures.) In addition, accepted methodologies will be used for sample analysis, and these methods will not be changed during the project.

SECTION 5

Sample Collection Procedures

A detailed description of sampling procedures is provided in the attached FSP and Appendix A of the FSP. Procedures are included that describe, at a minimum:

- Sample plan design considerations
- Sampling point selection
- Sample packing, handling, and shipment (including time considerations)
- Special conditions for sample container preparation and time requirements (tabulated)
- Preparation and use of trip blanks and field blanks
- Documentation of sampling activities

SECTION 6

Sample Custody

Essential to any sampling and analytical program is maintaining the integrity of the sample from collection to data reporting. This requires tracking the possession and handling of samples from the time of collection, through analysis, to final disposal. This documentation is referred to as chain-of-custody (CofC). Figure 6-1 shows an example of a CofC form. The essential components of this CofC are described in the FSP and summarized below.

Field Custody

The sample coordinator is responsible for the care and custody of samples until they are shipped or otherwise delivered to the laboratory custodian.

Transfer of Custody

The CofC form must be completed before samples are shipped. The persons involved in relinquishing and receiving the samples will sign, date, and note the time of sample receipt on the CofC form. The first such transfer may occur between the field sampler and the sample carrier. Another transfer may occur between the sample carrier and the laboratory sample custodian. Each sample shipment will be accompanied by a CofC record that identifies the contents of the shipment.

Laboratory Custody

Laboratory custody procedures are detailed in each laboratory's Quality Assurance Plan (LQAP). The laboratory custodian will verify that the custody seals on the sample shipment or the containers are intact and that the information on the CofC matches the actual contents. The laboratory custodian will also note any anomalies, such as broken bottles, elevated temperatures, and missing labels. The project-specific procedures for sample custody are described fully in the FSP.

Sample Disposal

Unless otherwise instructed, the analytical laboratory will dispose of unused sample portions, according to Resource Conservation and Recovery Act (RCRA) regulations and the LQAP, after the analyses have been completed and any outstanding issues between the contractor and the laboratory have been resolved.

FIGURE 6-1 EXAMPLE OF A CHAIN OF CUSTODY

CH2M HILL

QUALITY ANALYTICAL LABORATORIES

CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

CH2M HILL Project #

Purchase Order #

Project Name

Company Name/CH2M HILL Office

Project Manager & Phone #
Mr. [ ]
Ms. [ ]
Dr. [ ]

Report Copy to:

Requested Completion Date:

Sampling Requirements: SDWA [ ] NPDES [ ] RCRA [ ] OTHER ____

Sample Disposal: Dispose [ ] Return [ ]

Sampling Date	Sampling Time	Type COMP	Type GRAB	Matrix WATER	Matrix SOIL	CLIENT SAMPLE ID (9 CHARACTERS)	# OF CONTAINERS	LAB TEST CODES / ANALYSES REQUESTED

SHADED AREA -- FOR LAB USE ONLY

Lab 1 #

Lab 2 #

Quote #

Kit Request #

Project #

No. of Samples

Page

of

COC Rev

Login

LIMS Ver

Ack Gen

REMARKS

LAB 1 ID

LAB 2 ID

Sampled By & Title (Please sign and print name) Date/Time

Received By (Please sign and print name) Date/Time

Received By (Please sign and print name) Date/Time

Received By (Please sign and print name) Date/Time

Work Authorized By (Please sign and print name)

Relinquished By (Please sign and print name) Date/Time

Relinquished By (Please sign and print name) Date/Time

Relinquished By (Please sign and print name) Date/Time

Shipped Via UPS BUS Fed-Ex Hand Other____

Shipping #

Remarks

HAZWRAP/NESSA: Y N

QC Level: 1 2 3 Other: ____

COC Rec | ICE

Ana Req | TEMP

Cust Seal | Ph

Instructions and Agreement Provisions on Reverse Side

DISTRIBUTION: ORIGINAL - LAB, Yellow - LAB, Pink - Client

REV 11/92 FORM 340

SECTION 7

Equipment Calibration

Various instruments will be used in the field and in the laboratory to collect data and monitor site conditions. Proper calibration, maintenance, and use of these instruments is important for collecting quality data. A record of calibration and maintenance activities is as important as the data record itself in order to verify the delivery of quality data.

Field Equipment Calibration

The field equipment to be used during this investigation that will require calibration includes:

- pH Meter
- Conductivity Meter
- Dissolved Oxygen Meter

The pH meter, dissolved oxygen meter, and conductivity meter (which includes the capability to determine salinity and temperature) will be calibrated before and during each day's use according to procedures and schedules outlined in the Health and Safety Plan (HASP) and in the FSP. The standards which will be used to calibrate these instruments are shown in Table 7-1. Standards will be purchased as necessary from appropriate vendors. The flow meter will be calibrated before installation and checked again after retrieval.

If an individual suspects an equipment malfunction, the device shall be removed from service and tagged so that it is not inadvertently used, and the equipment manager notified so that a substitute piece of equipment can be used. Backup equipment will be available in the field for use in the event of a malfunction.

Equipment that fails calibration or becomes inoperable during use shall be removed from service and tagged so that it is not inadvertently used. Such equipment shall be repaired and satisfactorily recalibrated. Equipment that cannot be repaired will be replaced.

Results of activities performed using equipment that has failed recalibration shall be evaluated. If the results are adversely affected, the outcome of the evaluation will be documented and the task manager will be notified.

Laboratory Equipment Calibration

The laboratory itself is responsible for equipment and instrument calibration and maintenance. Manufacturer's guidance shall be followed for general upkeep. Laboratory calibration procedures are outlined in the LQAP.

Table 7-1 Calibration Standards	
Instrument	**Calibration Standard**
pH Meter	pH 4 and 7 Buffers
Conductivity Meter	EC 225 and 1,000 µs/cm
Dissolved oxygen meter	N/A

SECTION 8

Analytical Procedures

All laboratory analyses will be performed by an approved laboratory meeting U.S. Navy Level D quality control. The laboratories will be procured using the Basic Ordering Agreements (BOAs). Laboratory procedures to be used for the project are listed in Table 8-1.

Table 8-1
ANALYTICAL PROCEDURES

Analysis	Methodology
TCL Volatiles, Semivolatiles, and Pesticides/PCBs	U.S. EPA CLP Organics SOW (8/91)
Low Concentration Volatiles (for aqueous samples)	U.S. EPA CLP SOW for Low Concentration Water OLC02 (8/94)
TAL Metals and Cyanide	U.S. EPA CLP Inorganics SOW
Total Organic Carbon	EPA Method 415.2 for surface water EPA Method 415.1 for sediment
Hardness	EPA Method 130.1
Grain Size	ASTM D422-64 with ASTM D421-85 for prep

SECTION 9

Data Reduction, Validation, and Record Keeping

Data reduction and reporting are steps in the overall management and use of both field and laboratory data, and data validation is a step in the overall management and use of laboratory data. Figure 9-1 shows the flow of information and sample tracking forms.

Data Reduction

Data reduction, validation, and reporting will ensure that all documents for the investigations can be accounted for when they are completed. Accountable documents include items such as logbooks, field data records, correspondence, CofC records, analytical reports, data packages, and reports.

Definition

Analytical data collected will be computerized. Electronic data will be requested for all TCL and TAL analyses from the laboratory in a format agreed upon by the data manager. Other types of analytical data will be entered and then verified by spot-checking procedures. The sample manager will handle data entries that are unverified.

Background Data

Background data produced for internal records and not reported as part of the analytical data include the following: laboratory worksheets, laboratory notebooks, sample tracking system forms, maintenance records, calibration records, and associated quality control. These sources will be available for inspection and to determine the validity of data.

Data Validation

Validation of analytical data will be contracted by CH2M HILL in accordance with Navy Level D QA/QC requirements. The project, its objectives, and the intended use of the data will be discussed with the data validation personnel.

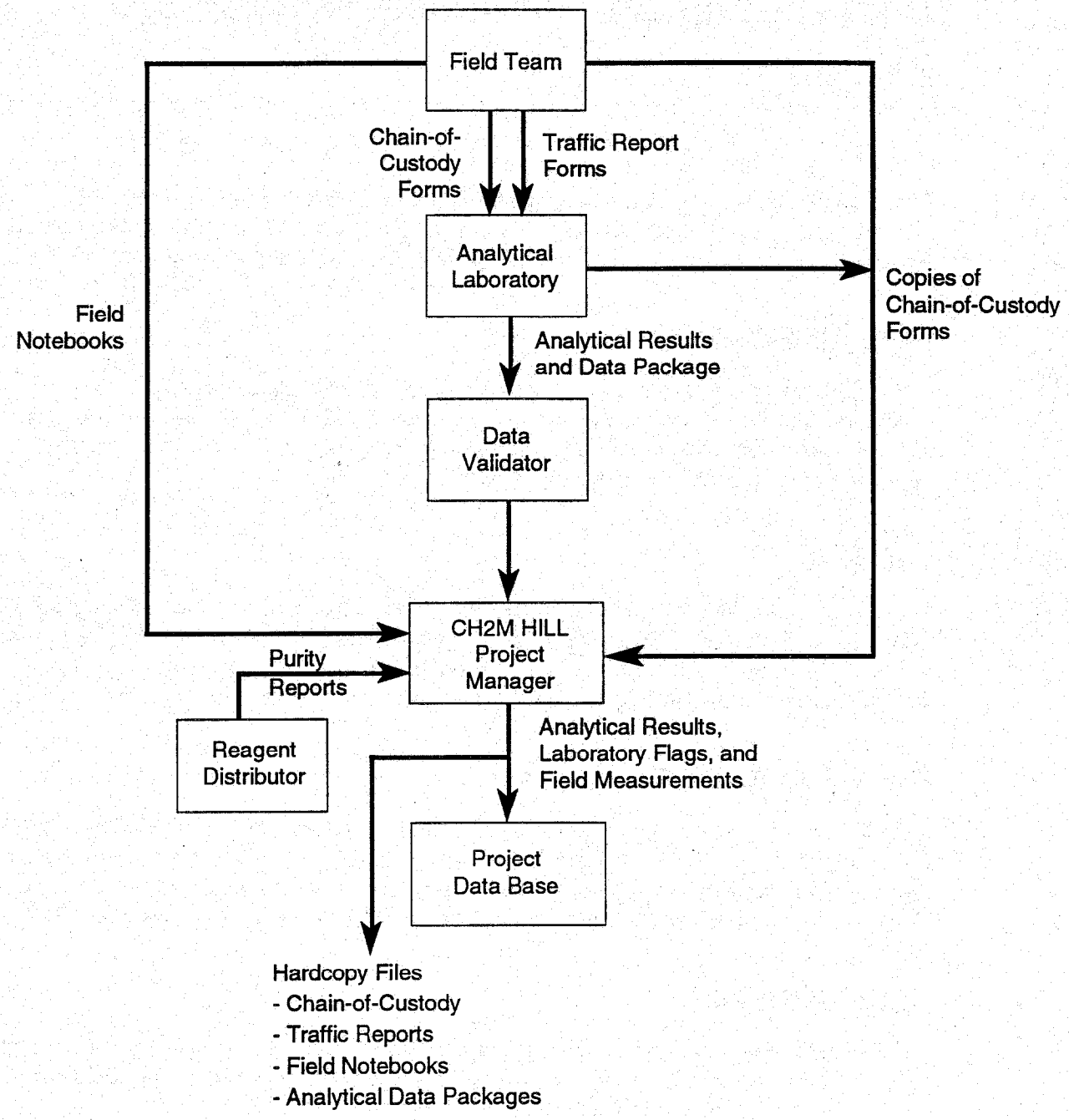

Figure 9-1
FLOW OF FORMS AND SAMPLE AND ANALYSIS INFORMATION

Data Records

The following describes procedures for maintaining the project's records:

- The task manager shall determine the records to be generated before the start of work. These records will be listed in the site-specific FSP.
- Records of field activities that support the integrity of samples shall be entered on bound and numbered pages. Such records shall be dated and signed or otherwise authenticated on the day of entry.
- Records retained on file shall be indexed. The indexing system shall include the location of records within the indexing system. (The indexing system shall be in alphabetical, chronological or numerical order, or as otherwise indicated in written procedures.)
- There shall be sufficient information in records to permit identification between the record and the item(s) or activity to which it applies. Identification of records will be by means that permit traceability.
- The records storage system shall provide for accurate retrieval of records without undue delay.

SECTION 10

Quality Control Checks

A number of QA/QC samples will be collected to check the adequacy of sample collection and analysis and to monitor laboratory performance. Duplicates, blanks, and spiked samples are used to determine if the sampling technique affects the analytical results, to measure the internal consistency of the samples, and to estimate any variance or bias in the analytical process. The field and laboratory QA/QC sampling procedures are described below.

Field Sampling Quality Control Procedures

Quality control duplicate samples and blanks are used to provide a measure of the internal consistency of the samples and an estimate of variance and bias. Table 10-1 shows the number of each type of field QC sample that should be collected for the number of investigative samples collected. Table 10-2 and Table 10-3 are summaries of the sediment and surface water samples (respectively) that will be collected and submitted to the laboratory. The tables show the collection frequencies of the field QC samples.

Table 10-1
SUMMARY OF QC COLLECTION FREQUENCIES

Type of QC Sample	Frequency Collected
Field Duplicate	One per 10 samples per matrix
Trip Blank	One per cooler containing samples for volatile analysis
Field Blank	One per week (if very windy or dusty, collect one per day)
Equipment Blank	One every day per matrix.
Matrix Spike/Matrix Spike Duplicate	One per matrix for each group of up to 20 samples sent to a single laboratory. MS/MSD is not required for low concentration organic samples.

One duplicate sample will be obtained for every 10 field samples collected. The sampling station from which the duplicate is taken will be randomly selected for each event. Each duplicate sample will be split evenly into two sample containers and submitted for analysis as two independent samples.

Matrix spike/matrix spike duplicates (MS/MSD) will be collected at the rate of one for every 20 field samples collected. MS/MSD samples give an indication of laboratory analysis accuracy and precision within the sample matrix.

Blanks provide a measure of cross-contamination sources, decontamination efficiency, and other potential errors that can be introduced from sources other than the sample. Three types of blanks can be generated during sampling activities: trip blanks, field blanks, and equipment rinsate blanks.

One trip blank will be included in each cooler used for the daily shipment of volatile samples. If more than one cooler is being sent on a given day, all of the VOC samples should be placed in one cooler, if possible, to minimize the number of trip blanks needed. The trip blanks will be prepared before each sampling event, shipped or transported to the field with the sampling bottles, and returned unopened for analysis. Trip blanks will indicate if there is any contamination during shipment to the field, from storage in the field, or from shipment from the field to the analytical laboratory.

One equipment blank per sample media will be obtained for every day of sampling. Equipment blanks will give an indication of the efficiency of decontamination procedures.

One field blank will be collected for each week of sampling. Field blanks are used to determine the chemical quality of water used for such procedures as decontamination and blank collection.

Laboratory Analytical Quality Control Procedures

The analytical laboratory will use the quality control elements including matrix spikes, matrix spike duplicates, and laboratory blanks as specified in the *Navy Installation Restoration Laboratory Quality Assurance Guide, Interim Guidance Document*, February, 1996. Field quality control procedures are provided in Appendix A of the FSP.

Matrix Spike/Matrix Spike Duplicate

Matrix spike/matrix spike duplicates will be spiked by the laboratory in two separate aliquots of a sample selected by the sampler from each batch of 20 field samples. The MS/MSDs will be used to assess accuracy and precision. The MSD is identical to the MS; both are analyzed to determine the reproducibility of the results. The sampler will collect triple volume of one sample to provide the laboratory with enough material to analyze the sample, the spiked sample, and the spiked sample duplicate. MS/MSDs are not required for the low concentration method, and the laboratory performs other QC (lab control samples) with this method.

Table 10-2
SUMMARY OF SEDIMENT SAMPLES SUBMITTED TO THE OFFSITE LABORATORY FOR ANALYSIS

Matrix	Laboratory Parameter	Samples	Field Duplicates[1]	Field Blanks[2]	Trip Blanks[3]	Matrix Spikes[4]	Equipment Blank[5]	Matrix Total
Sediment	TCL Volatiles	14	2	1	2	1	2	21
	TCL Semivolatiles	14	2	1	0	1	2	19
	TCL Pesticides/PCBs	14	2	1	0	1	2	19
	TAL Metals and Cyanide	14	2	1	0	1	2	19
	TOC	14	2	1	0	1	2	19
	Grain Size	14	2	0	0	0	0	16

Notes:
[1]Field duplicates are collected at a frequency of 1 per 10.
[2]Field blanks are collected at a frequency of 1 per source per event (1 per week of sampling).
[3]Trip blanks are shipped with samples submitted for volatiles analysis. Trip blanks are used to monitor contamination that could be introduced during transportation. Trip blanks are collected at a frequency of 1 per cooler of volatiles samples.
[4]Matrix spike/matrix spike duplicates (MS/MSD) are collected at a frequency of 1 per 20. MS/MSDs represent samples for which extra volume must be collected for the laboratory to perform required QC analyses. Triple the normal volumes will be collected for all analyses.
[5]Equipment blanks are collected at a frequency of 1 every day.
Note: This table is based on Navy Level D QA/QC requirements.

Table 10-3
SUMMARY OF SURFACE WATER SAMPLES SUBMITTED TO THE OFFSITE LABORATORY FOR ANALYSIS

Matrix	Laboratory Parameter	Samples	Field Duplicates[1]	Field Blanks[2]	Trip Blanks[3]	Matrix Spikes[4]	Equipment Blanks[5]	Matrix Total
Surface Water	Low Concentration VOC	28	3	2	2	0	2	37
	TCL Semivolatiles	28	3	2	0	2	2	37
	TCL Pesticides/PCBs	28	3	2	0	2	2	37
	TAL Filtered Metals	28	3	2	0	2	2	37
	TAL Cyanide	28	3	2	0	2	2	37
	TOC	28	3	2	0	2	2	37

Notes:
[1]Field duplicates are collected at a frequency of 1 per 10.
[2]Field blanks are collected at a frequency of 1 per source per event (1 per week of sampling).
[3]Trip blanks are shipped with water samples submitted for volatiles analysis. Trip blanks are used to monitor contamination that could be introduced during transportation. Trip blanks are collected at a frequency of 1 per cooler of volatiles samples.
[4]Matrix spike/matrix spike duplicates (MS/MSD) are collected at a frequency of 1 per 20. MS/MSDs represent samples for which extra volume must be collected for the laboratory to perform required QC analyses. Triple the normal volumes will be collected for volatiles samples and double the normal volumes for inorganic samples.
[5]Equipment blanks are collected at a frequency of 1 per day and analyzed at a frequency of 1 every other day.
Note: This table is based on Navy Level D QA/QC requirements.

SECTION 11

Performance and Systems Audits

Both field and laboratory audits will be conducted.

Laboratory Performance and Systems Audits

The analytical laboratories will conduct internal quality control checks as indicated in each laboratory's LQAP. The laboratories are subject to external audits by the Navy and CH2M HILL.

Field Team Performance and Systems Audits

A performance audit will be conducted on an as-needed basis by the project manager during the sampling activities to verify that proper sampling and documentation procedures presented in the QAPP and the FSP are followed and that subsequent sample data are valid. The audit will focus on the details of the QA program. The audit checklist serves as the guide for performing audits for field procedures, is shown in Figure 1-1. The audit will evaluate the following:

- Project responsibilities
- Sample collection and preservation procedures
- Equipment decontamination procedures
- Field equipment calibration procedures
- Sample custody procedures
- Document control
- Sample identification system
- QC corrective action procedures

An audit report summarizing any results and corrections will be prepared and filed in the project files. Significant variances from established procedures will be reported to the project manager.

Figure 11-1
FIELD PERFORMANCE AUDIT CHECKLIST

Project Responsibilities

Project No.: _____ Date: _____

Project Location: _____ Signature: _____

Team Members: _____

Yes ___ No ___ 1) Was a SAP Prepared?
Comments _____

Yes ___ No ___ 2) Was a briefing held for project participants?
Comments _____

Yes ___ No ___ 3) Were additional instructions given to project participants?
Comments _____

Sample Collection

Yes ___ No ___ 1) Is there a written list of sampling locations and descriptions?
Comments _____

Yes ___ No ___ 2) Are samples collected as stated in the FSP?
Comments _____

Yes ___ No ___ 3) Are samples collected in the type of containers specified in the FSP?
Comments _____

Figure 11-1
FIELD PERFORMANCE AUDIT CHECKLIST
(Continued)

Yes ___ No ___ 4) Are samples preserved as specified in the FSP?
Comments _____

Yes ___ No ___ 5) Are the number, frequency, and type of samples collected as specified in the FSP?
Comments _____

Yes ___ No ___ 6) Are quality assurance checks performed as specified in the FSP?
Comments _____

Yes ___ No ___ 7) Are photographs taken and documented as specified in the FSP?
Comments _____

Document Control

Yes ___ No ___ 1) Have any accountable documents been lost?
Comments _____

Yes ___ No ___ 2) Have any accountable documents been voided?
Comments _____

Yes ___ No ___ 3) Have any accountable documents been disposed of?
Comments _____

Figure 11-1
FIELD PERFORMANCE AUDIT CHECKLIST
(Continued)

Yes ___ No ___ 4) Are the samples identified with sample tags?
Comments _____

Yes ___ No ___ 5) Are blank and duplicate samples properly identified?
Comments _____

Yes ___ No ___ 6) Are samples listed on a chain-of-custody record?
Comments _____

Yes ___ No ___ 7) Is chain-of-custody documented and maintained?
Comments _____

WDCR906/018.WP5

SECTION 12

Preventive Maintenance

Routine maintenance procedures and schedules for sampling equipment are described in the manufacturer's instruction manuals. All records of inspection and maintenance will be dated and documented in the field notebook.

Maintenance procedures and schedules for all field and laboratory analytical instruments will follow the recommendations of the equipment manufacturers. Routine laboratory equipment maintenance will be performed by laboratory personnel as needed or as indicated in the LQAP. All records of inspection and maintenance will be dated and documented in laboratory record books.

Critical spare parts for the pH, OVM, conductivity meter, and explosimeter include batteries, electrodes, and membranes. They will be included in the sampling kits to minimize downtime. In addition, back-up meters will be available, if needed. Spare parts will be purchased from accepted vendors.

SECTION 13

Data Assessment Procedures

The precision and accuracy of data will be routinely assessed to ensure that they meet the requirements of the DQOs.

All data will be validated before interpretation by a subcontractor. The validation will be performed according to *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, February 1994, and the *USEPA Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses*, January 1993.

Data validation will be performed by an independent contractor, as it would not be appropriate for CH2M HILL to validate data collected by CH2M HILL staff. Data that should be qualified will be flagged with the appropriate symbol. Results for field and equipment blanks will be reviewed, and the data will be qualified further, if necessary. Finally, the data set as a whole will be examined for consistency, anomalous results, and reasonableness.

SECTION 14

Corrective Actions

The project manager is responsible for initiating corrective actions. Corrective action steps will include problem identification, investigation responsibility assignment, action to eliminate the problem, increased monitoring of the effectiveness of the corrective action, and verification that the problem has been eliminated.

Examples of corrective actions include, but are not limited to, correcting CofC forms, analysis reruns (if holding time criteria permit), recalibration with fresh standards, replacement of sources of blank contamination, examination of calculation procedures, additional training in sample preparation and analysis, reassignment of analytical responsibilities using a different batch of containers, or recommending an audit of laboratory procedures. Additional approaches may include:

- Resampling and analyzing
- Evaluating and amending sampling and analytical procedures
- Accepting the data and acknowledging the level of uncertainty or inaccuracy by flagging the data and providing an explanation for the qualification.

SECTION 15

Quality Assurance Reports

A QA report will be completed at the end of the field activity to summarize the QA/QC status of the project and any problems. The report will be an assessment of the measured QA parameters (for example, precision and accuracy), results of performance audits, any reported non-conformance, and any significant QA problems and the recommended solutions. Any change in the QAPP will be summarized in a report or letter and sent to LANTDIV and distributed to the CH2M HILL project team.

Draft Final

Field Sampling Plan for the Post Remediation Ecological Monitoring Camp Allen Landfill

Norfolk Naval Base
Norfolk, Virginia

Prepared for

Department of the Navy
Atlantic Division
Naval Facilities Engineering Command

Contract No. N62470-95-D-6007
CTO-0011

August 1996

Prepared by

CH2M HILL
Federal Group, Ltd.
Herndon, Virginia

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Section 1

Introduction

This Field Sampling Plan (FSP) documents procedures and practices to be followed during the Post Remediation Ecological Monitoring at the Camp Allen Landfill at the Naval Base, Norfolk. Samples will be collected from various media, including surface water and sediment. The following sections document the sampling program for each media. All sample analyses will be performed in accordance with standard EPA methods and procedures by a contracted laboratory that fulfills all requirements of the U.S. Navy's QA/QC Program Manual and EPA's Contract Laboratory Program. A signed certificate of analysis will be provided with each laboratory analysis, along with a certificate of compliance certifying that all work was performed in accordance with the applicable federal, state, and local regulations. All analyses will be performed following U.S. Navy guidance for Level D. Table 1-1 lists the analytical parameters included on EPA's Target Compound List (TCL volatiles, semivolatiles, and pesticides/PCBs) and Target Analyte List (TAL) for inorganics (metals and cyanide).

Surface Water and Sediment Investigation

The sediment sampling program includes the collection of surface water and sediment samples from several locations along Bousch Creek. The number of samples and specific analyses to be performed are outlined below. Table 1-2 summarizes the surface water and sediment sampling program giving the sampling location and analyses to be performed for each sample.

In order to achieve the lower detection limits required for risk assessment, the volatile fraction of the aqueous organic samples will be analyzed by the EPA Contract Laboratory Program (CLP) Statement of Work (SOW) for Low Concentration Water (OLC02).

Surface Water Sampling

A total of twenty-eight surface water samples will be collected during two sampling events during the Post Remedial Ecological Monitoring at the Camp Allen Landfill. Fourteen surface water samples will be collected during low tide and the same fourteen sampling locations will be revisited and sampled during high tide conditions. Prior to sample collections field measurements of pH, dissolved oxygen, salinity, conductivity, and temperature will be made at each sampling location. Figures 1-1 and 1-2 depict the proposed surface water sampling locations.

Sampling locations will be distributed along the Bousch Creek drainage feature to best determine if contaminants found at the Camp Allen Landfill are present in the creek. All samples will be analyzed for TCL organics (volatiles, semivolatiles, and pesticides/PCBs), TAL inorganics (metals and cyanide), and hardness. The volatile fraction of the organic sample will be analyzed using the EPA low concentration water method OLC02.

Sediment Sampling

A total of fourteen sediment samples will be collected from Bousch Creek. Sediment samples will be collected after the collection of surface water samples so that surface water samples are not affected by sediment disturbances. The sediment sampling locations are shown on Figures 1-1 and 1-2. All samples will be analyzed for TCL organics, TAL inorganics, TOC, and grain size.

Surveying

All surface water and sediment sampling locations will be located by a subcontracted surveyor licensed in the State of Virginia. Each sampling location will be surveyed using state plane coordinates with vertical elevations referenced to USGS vertical datum.

Table 1-1
ANALYTICAL PARAMETERS

Volatile Organic Compounds on Target Compound List (TCL) (Sediment Samples)	
Acetone	1,2-Dichloropropane
Benzene	cis-1,3-Dichloropropene
Bromoform	trans-1,3-Dichloropropene
Bromodichloromethane	Ethylbenzene
Bromomethane	2-Hexanone
2-Butanone	4-Methyl-2-Pentanone
Carbon Disulfide	Methylene Chloride
Carbon Tetrachloride	Styrene
Chlorobenzene	1,1,2,2-Tetrachloroethane
Chloroethane	Tetrachloroethene
Chloroform	Toluene
Chloromethane	1,1,1-Trichloroethane
Dibromochloromethane	1,1,2-Trichloroethane
1,1-Dichloroethane	Trichloroethene
1,2-Dichloroethane	Vinyl Chloride
1,1-Dichloroethene	Xylenes (total)
1,2-Dichloroethene (total)	

Volatile Organic Compounds Under Low Concentration Method OLC02 (Surface Water Samples)	
Acetone	1,1-Dichloroethene
Benzene	1,2-Dichloroethene (total)
Bromoform	cis-1,2-Dichloroethane
Bromochloromethane	trans-1,2-Dichloroethene
Bromodichloromethane	1,2-Dichloropropane
Bromomethane	cis-1,3-Dichloropropene
2-Butanone	trans-1,3-Dichloropropene
Carbon Disulfide	1,2,4-Trichlorobenzene
Carbon Tetrachloride	Ethylbenzene
Chlorobenzene	2-Hexanone
Chloroethane	4-Methyl-2-Pentanone
Chloroform	Methylene Chloride
Chloromethane	Styrene
1,2-Dibromo-3-chloropropane	1,1,2,2-Tetrachloroethane
Dibromochloromethane	Tetrachloroethene
1,2-Dibromoethane	Toluene
1,2-Dichlorobenzene	1,1,1-Trichloroethane
1,3-Dichlorobenzene	1,1,2-Trichloroethane
1,4-Dichlorobenzene	Trichloroethene
1,1-Dichloroethane	Vinyl Chloride
1,2-Dichloroethane	Xylenes (total)

Table 1-1

ANALYTICAL PARAMETERS

Semivolatile Organic Compounds on Target Compound List (TCL)

1,2-Dichlorobenzene	2,4-Dinitrophenol
1,3-Dichlorobenzene	4-Nitrophenol
1,4-Dichlorobenzene	Dibenzofuran
Phenol	2,4-Dinitrotoluene
bis-(2-Chloroethyl)ether	Diethylphthalate
2-Chlorophenol	4-Chlorophenyl-phenylether
2-Methylphenol	Fluorene
2,2′-oxybis(1-Chloropropane)	4-Nitroaniline
4-Methylphenol	4,6-Dinitro-2-methylphenol
N-Nitroso-di-n-propylamine	N-Nitrosodiphenylamine
Hexachloroethane	4-Bromophenyl-phenylether
Nitrobenzene	Hexachlorobenzene
Isophorone	Pentachlorophenol
2-Nitrophenol	Phenanthrene
2,4-Dimethylphenol	Anthracene
bis-(2-Chloroethoxy)methane	Di-n-butylphthalate
2,4-Dichlorophenol	Carbazole
1,2,4-Trichlorobenzene	Fluoranthene
Naphthalene	Pyrene
4-Chloroaniline	Butylbenzylphthalate
Hexachlorobutadiene	3,3′-Dichlorobenzidine
4-Chloro-3-methylphenol	Benzo(a)anthracene
2-Methylnaphthalene	Chrysene
Hexachlorocyclopentadiene	bis-(2-Ethylhexyl)phthalate
2,4,6-Trichlorophenol	Di-n-octylphthalate
2,4,5-Trichlorophenol	Benzo(b)fluoranthene
2-Chloronaphthalene	Benzo(k)fluoranthene
2-Nitroaniline	Benzo(a)pyrene
Dimethylphthalate	Indeno(1,2,3-cd)pyrene
Acenaphthylene	Dibenz(a,h)anthracene
2,6-Dinitrotoluene	Benzo(g,h,i)perylene
3-Nitroaniline	
Acenaphthene	

Table 1-1

ANALYTICAL PARAMETERS

Pesticides and PCBs on Target Compound List (TCL)	
alpha-BHC	4,4-DDT
beta-BHC	Methoxychlor
delta-BHC	Endrin ketone
gamma-BHC (Lindane)	Endrin aldehyde
Heptachlor	alpha-Chlordane
Aldrin	gamma-Chlordane
Heptachlor epoxide	Toxaphene
Endosulfan I	Aroclor-1016
Dieldrin	Aroclor-1221
4,4′-DDE	Aroclor-1232
Endrin	Aroclor-1242
Endosulfan II	Aroclor-1248
4,4′-DDD	Aroclor-1254
Endosulfan sulfate	Aroclor-1260

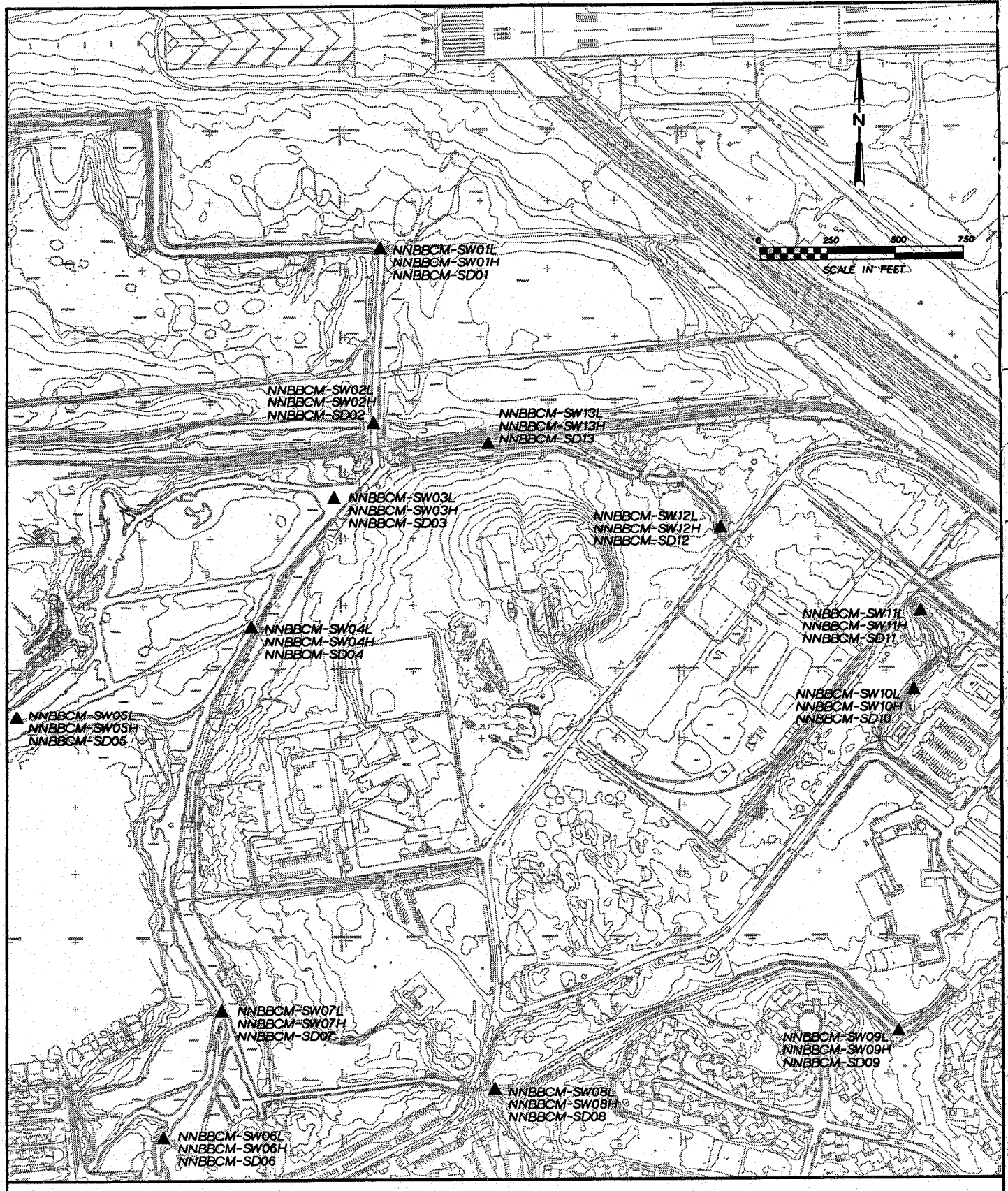
Inorganics on Target Analyte List (TAL)	
Aluminum	Lead
Antimony	Magnesium
Arsenic	Manganese
Barium	Mercury
Beryllium	Nickel
Cadmium	Potassium
Calcium	Selenium
Chromium	Silver
Cobalt	Sodium
Copper	Thallium
Cyanide	Vanadium
Iron	Zinc

Table 1-2
SOIL AND SEDIMENT SAMPLING PROGRAM FOR POST REMEDIATION ECOLOGICAL MONITORING
CAMP ALLEN LANDFILL

Site	Sampling Location	Low Level Volatiles OLC02/ Hardness	TCL VOC	TCL SVOC	TCL Pest/PCB	TAL Metals and Cyanide (total)	Total Organic Carbon (TOC)	Grain Size
Bousch Creek	NNBBCM-SW01L	X		X	X	X		
Bousch Creek	NNBBCM-SW01H	X		X	X	X		
Bousch Creek	NNBBCM-SW02L	X		X	X	X		
Bousch Creek	NNBBCM-SW02H	X		X	X	X		
Bousch Creek	NNBBCM-SW03L	X		X	X	X		
Bousch Creek	NNBBCM-SW03H	X		X	X	X		
Bousch Creek	NNBBCM-SW04L	X		X	X	X		
Bousch Creek	NNBBCM-SW04H	X		X	X	X		
Bousch Creek	NNBBCM-SW05L	X		X	X	X		
Bousch Creek	NNBBCM-SW05H	X		X	X	X		
Bousch Creek	NNBBCM-SW06L	X		X	X	X		
Bousch Creek	NNBBCM-SW06H	X		X	X	X		
Bousch Creek	NNBBCM-SW07L	X		X	X	X		
Bousch Creek	NNBBCM-SW07H	X		X	X	X		
Bousch Creek	NNBBCM-SW08L	X		X	X	X		
Bousch Creek	NNBBCM-SW08H	X		X	X	X		
Bousch Creek	NNBBCM-SW09L	X		X	X	X		
Bousch Creek	NNBBCM-SW09H	X		X	X	X		
Bousch Creek	NNBBCM-SW10L	X		X	X	X		
Bousch Creek	NNBBCM-SW10H	X		X	X	X		
Bousch Creek	NNBBCM-SW11L	X		X	X	X		
Bousch Creek	NNBBCM-SW11H	X		X	X	X		
Bousch Creek	NNBBCM-SW12L	X		X	X	X		
Bousch Creek	NNBBCM-SW12H	X		X	X	X		
Bousch Creek	NNBBCM-SW13L	X		X	X	X		
Bousch Creek	NNBBCM-SW13H	X		X	X	X		
Bousch Creek	NNBBCM-SW14L	X		X	X	X		
Bousch Creek	NNBBCM-SW14H	X		X	X	X		
Bousch Creek	NNBBCM-SD01		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD02		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD03		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD04		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD05		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD06		X	X	X	X	X	X

Table 1-2
SOIL AND SEDIMENT SAMPLING PROGRAM FOR POST REMEDIATION ECOLOGICAL MONITORING
CAMP ALLEN LANDFILL

Site	Sampling Location	Low Level Volatiles OLC02 Hardness	TCL VOC	TCL SVOC	TCL Pest/PCB	TAL Metals and Cyanide (total)	Total Organic Carbon (TOC)	Grain Size
Bousch Creek	NNBBCM-SD06		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD07		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD08		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD09		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD10		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD11		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD12		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD13		X	X	X	X	X	X
Bousch Creek	NNBBCM-SD14		X	X	X	X	X	X



LEGEND

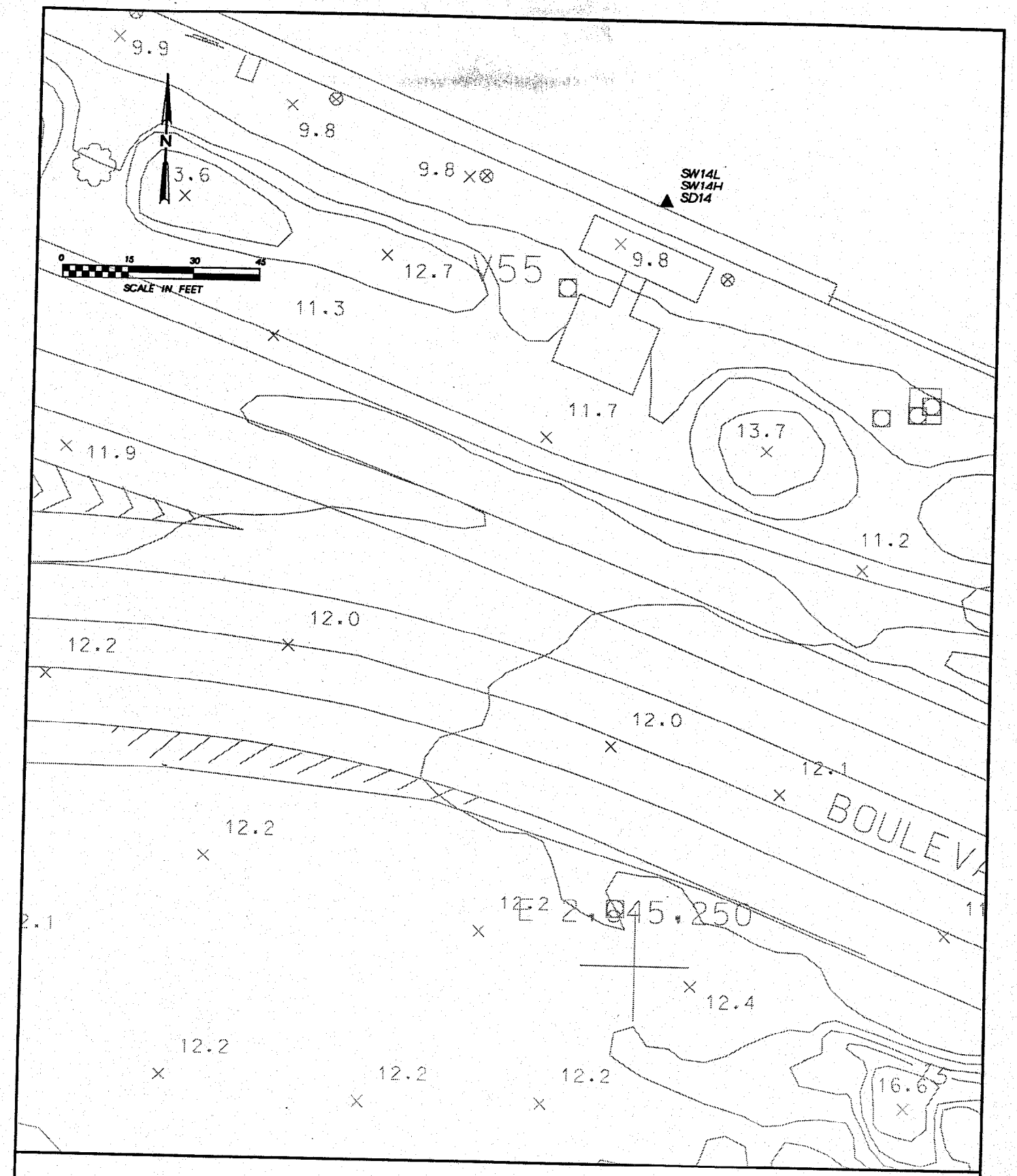
▲ SURFACE WATER QUALITY AND SEDIMENT SAMPLING LOCATION

Figure 1-1

PROPOSED SURFACE WATER QUALITY AND SEDIMENT SAMPLING LOCATIONS
Naval Base, Norfolk

CH2MHILL

11-APR-1996 4363r002.dlv



LEGEND

▲ *SURFACE WATER QUALITY AND SEDIMENT SAMPLING LOCATION*

Figure 1-2
PROPOSED SURFACE WATER QUALITY AND SEDIMENT SAMPLING LOCATIONS
Naval Base, Norfolk

CH2MHILL

11-APR-1996 4363f001.dlv

Section 2

Sampling Operations

All aspects of the sampling operations will conform to U.S. Navy specifications and guidelines. This includes the frequency of collecting and providing QC samples: duplicates; trip, field, and equipment blanks; and matrix spike and matrix spike duplicates.

Surface Water and Sediment Sampling Techniques

The Post Remediation Ecological Monitoring at the Camp Allen Landfill will involve the collection of surface water and sediment samples. Surface water samples will be collected with a Van Dorn sampling device. Water depths at sample locations will influence the type of sediment sampler that is required. Because sediment grain size characteristics are unknown, a preliminary effort will be made to test the ability of a sediment coring device near each sample location before samples are collected to determine whether sediment characteristics are suitable for retaining material in the corer. If it is determined that, due to grain size, currents of other factors, the corer would not be effective at all Bousch Creek locations, the Ponar Dredge grab sampler would be used throughout. The purpose of this assessment is to ensure that a uniform sampling technique can be used in the creek. Sampling at upstream locations on an ebbing tide will likely allow the use of waders to access mid-channel areas, whereas sampling during high tide will require the use of a small boat at many sites. Water depths at the time of sampling will be determined by the use of a metered lead line. The Standard Operating Procedures (SOPs) for the collection of surface water and sediment samples are included in Attachment A. A brief explanation of each sampling technique is provided below.

Direct Collection Surface Water Sampling

At sampling locations with 2 feet of water or less, direct collection of surface water samples will be performed. Direct collection involves submersing the sampling container directly into the surface water body. Care will be taken to ensure that the body of the sampling container is facing downstream so that any sediment disturbed during the immersion of the container does not enter the sampling vessel.

Samples will be placed in containers and preserved according to Navy Level D protocol and analyzed within the proper holding time. For volatile organic analysis (VOC) the bottles will be filled so as to minimize aeration of the samples. Sample vials will be filled completely and capped to prevent the entrapment of any air bubbles in the vial.

The bottle cap should be removed carefully from the laboratory cleaned sample bottle. The cap should not be laid down nor the inside touched. At no time should the inside of the bottle come into contact with anything other than the sample.

Van Dorn Bottle Surface Water Sampling

At sampling locations with greater than 2 feet of water, a Van Dorn bottle or sampler will be used to collect the surface water sample from mid-depth in the middle of the channel. The Van Dorn bottle consists of a 5-liter sampling vessel sealed at each end by a rubber stopper. The rubber stoppers are held in place by a length of stretchable rubber tubing which runs through the center of the sampling vessel. During sample collection, the rubber stoppers are pulled from the ends of the sampling vessel stretching the rubber tubing which connects them. The stoppers are locked in the open position via a spring loaded peg assembly. The Van Dorn bottle is lowered to the desired sampling depth and a steel messenger weight is sent down the rope. When the messenger weight contacts the spring-loaded peg assembly, the rubber stoppers are released and seal the ends of the bottle. The Van Dorn Bottle is retrieved, and the containers are filled through a sampling port on the bottom of the bottle.

Samples will be placed in containers and preserved according to Navy Level D protocol and analyzed within the proper holding time. For VOCs the bottles will be filled so as to minimize aeration of the samples. Sample vials will be filled completely and capped to prevent the entrapment of any air bubbles in the vial.

The bottle cap should be removed carefully from the laboratory-cleaned sample bottle. The cap should not be laid down nor the inside touched. At no time should the inside of the bottle come into contact with anything other than the sample.

All appropriate preservatives will be added to the sample containers by the contracted laboratory before shipment to the CH2M HILL field team. During the collection of surface water samples, care will be taken to ensure that any pre-added preservative is not rinsed from the sampling container during sample collection. TCL VOC samples will be preserved with hydrochloric acid (HCl); TAL metals samples will be preserved with nitric acid (HNO_3), and cyanide samples will be preserved with sodium hydroxide (NaOH). All samples will be kept cool at 4°C, using bagged ice.

Table 2-1 presents the required containers, preservatives, and holding times for surface water samples. Table 2-2 summarizes the surface water samples to be submitted for analyses.

PVC Core Sampling

The preferred sediment coring device is a polyvinyl chloride (PVC) tube. As noted above, an effort will be made to determine the effectiveness of this type of sampler at the Bousch Creek sampling locations so that a uniform technique can be selected and used at each creek location.

A PVC coring device will be used to collect sediment samples from beneath shallow surface water bodies. A 2-foot long PVC coring tube will be attached to the appropriate length of extension pipe. The coring tube will be sealed at the top and have a 1/4-inch diameter drainage hole drilled approximately 1-inch from the sealed end. The drainage hole will allow the water column trapped inside the PVC coring tube to escape as the tube is pushed into the sediments. The coring device will be manually pushed into the Bousch Creek sediments to a depth of up to 1-foot, filling the coring tube completely and expelling all water. The coring tube will then be retrieved and the sample extruded using a stainless steel spatula. The top 10 centimeters of sediment would be sliced and retained for analysis.

Table 2-1
REQUIRED CONTAINERS, PRESERVATIVES, AND HOLDING TIMES FOR SURFACE WATER SAMPLES

Analysis	Sample Container	Preservative	Holding Time	Volume of Sample Collected
TCL Volatiles and Low Concentration Volatiles	Three 40-ml glass vial w/teflon lined cap	HCl to pH <2; Cool to 4°C	14 days	Fill completely; no air bubbles
TCL Semivolatiles	2 1-liter amber bottle w/teflon lined cap	Cool to 4°C	7 days to extraction, 40 days to analysis	Fill to shoulder
TCL Pest/PCB	2 1-liter amber bottle w/teflon lined cap	Cool to 4°C	7 days to extraction, 40 days to analysis	Fill to shoulder
TAL Filtered Metals	1-liter polyethylene bottle for each analysis	HNO_3 to pH <2; Cool to 4°C	6 months	Fill to shoulder
TAL Cyanide	1-liter bottle	NaOH to pH > 12; Cool to 4°C	14 days	Fill to shoulder
Hardness	1-liter bottle	HNO_3 to pH <2; Cool to 4°C	6 months	Fill to shoulder

Notes:

VOC aqueous field QC samples associated with the soil and sediment samples will be analyzed for TCL volatiles. VOC field QC samples associated with the groundwater and surface water samples will be analyzed for Low Concentration volatiles.

Table 2-2
SUMMARY OF SURFACE WATER SAMPLES SUBMITTED TO THE OFFSITE LABORATORY FOR ANALYSIS

Matrix	Laboratory Parameter	Samples	Field Duplicates[1]	Field Blanks[2]	Trip Blanks[3]	Matrix Spikes[4]	Equipment Blanks[5]	Matrix Total
Surface Water	Low Concentration VOC	28	3	1	2	0	2	35
	TCL Semivolatiles	28	3	1	0	1	2	34
	TCL Pesticides/PCBs	28	3	1	0	1	2	34
	TAL Filtered Metals	28	3	1	0	1	2	34
	TAL Cyanide	28	3	1	0	1	2	34
	Hardness	28	3	1	0	1	2	34

Notes:
[1]Field duplicates are collected at a frequency of 1 per 10.
[2]Field blanks are collected at a frequency of 1 per source per event (1 per week of sampling).
[3]Trip blanks are shipped with water samples submitted for volatiles analysis. Trip blanks are used to monitor contamination that could be introduced during transportation. Trip blanks are collected at a frequency of 1 per cooler of volatiles samples.
[4]Matrix spike/matrix spike duplicates (MS/MSD) are collected at a frequency of 1 per 20. MS/MSDs represent samples for which extra volume must be collected for the laboratory to perform required QC analyses. Triple the normal volumes will be collected for volatiles samples and double the normal volumes for inorganic samples.
[5]Equipment blanks are collected at a frequency of 1 per day.
Note: This table is based on Navy Level D QA/QC requirements.

A new coring tube will be used at each sampling location, thus reducing the possibility of cross contamination at sampling locations.

The VOC sample containers will be filled first from the top 10 centimeters of sediment. The sample will be placed directly into the VOC sample container to minimize the volatilization of organic compounds. The remaining sample volume from the top 10 centimeters of sediment will be placed into a stainless-steel bowl and mixed thoroughly. After mixing, all other sample containers will be filled.

Ponar Dredge Sampling

A Ponar Dredge may be necessary for collecting sediment samples from beneath any surface water at the Willoughby Bay outfall location because water depths are assumed to be greater than 20 feet and the sediments are assumed to be mainly sand and lacking cohesiveness. If it is determined that the coring device will not be effective at all of the creek locations, the Ponar Dredge sampler will be used for all of the samples; the goal being to use a uniform sampling technique. The ponar dredge is a "clamshell" type sampling device consisting of the bucket/jaws and the sampler arms. During sampling activities, a length of rope is attached to a ring on the top of the sampler arms. The sampler arms are then pushed towards the bucket to open the sampler jaws. The jaws are locked in the open position by inserting a spring-loaded steel pin through a small hole in the arms. The sampler is lifted by the rope, with the sampler's weight creating the tension which holds the locking pin in place. The sampler is lowered until the sediments are encountered, pulled up approximately 6-inches, and allowed to free fall. With the tension relieved, the spring on the locking pin forces the pin out of the hole in the arms. As the sampler is retrieved the jaws close, trapping the sediment sample inside. Any surface water entrapped in the sampler is slowly decanted through a screened port on the top of the ponar.

The top 10 centimeters of the sample will be used for analysis. The VOC sample containers will be filled first. The sample will be placed directly into the VOC sample container to minimize the volatilization of organic compounds. The remaining sample volume from the top 10 centimeters will be placed into a stainless-steel bowl and mixed thoroughly. After mixing, all other sample containers will be filled.

All sediment samples will be placed in clean glass containers provided by the laboratory. Any sample that is split for duplicate analysis will be mixed thoroughly before being split (except for VOCs). Table 2-3 presents the required containers, preservatives, and holding times for sediment samples. Table 2-4 presents a summary of sediment samples to be submitted for analyses.

Equipment Decontamination

All non-dedicated sampling equipment will be decontaminated prior to the beginning of sampling activities and after each use. Specific field decontamination procedures are presented in Attachment A.

Table 2-3
REQUIRED CONTAINERS, PRESERVATIVES, AND HOLDING TIMES FOR SEDIMENT SAMPLES

Analysis	Sample Container	Preservative	Holding Time	Volume of Sample Collected
TCL Volatiles	4-oz glass bottle with teflon-lined cap	Cool to 4°C	14 days	Fill completely
TCL Semivolatiles	Two 4-oz glass bottles with teflon-lined cap	Cool to 4°C	14 days	Fill completely
TCL Pest/PCB	Two 4-oz glass bottles with teflon-lined cap	Cool to 4°C	14 days	Fill completely
TAL Inorganics	4-oz glass bottle with teflon-lined cap	Cool to 4°C	6 months	Fill to shoulder
TOC	8-oz glass bottle	Cool to 4°C	28 days	Fill to shoulder

Note:

Refer to Table 2-1 for the required containers, preservatives, and holding times for the associated aqueous field quality control samples.

Table 2-4
SUMMARY OF SEDIMENT SAMPLES SUBMITTED TO THE OFFSITE LABORATORY FOR ANALYSIS

Matrix	Laboratory Parameter	Samples	Field Duplicates[1]	Field Blanks[2]	Trip Blanks[3]	Matrix Spikes[4]	Equipment Blank[5]	Matrix Total
Sediment	TCL Volatiles	14	2	1	2	1	2	21
	TCL Semivolatiles	14	2	1	0	1	2	19
	TCL Pesticides/PCBs	14	2	1	0	1	2	19
	TAL Metals and Cyanide	14	2	1	0	1	2	19
	TOC	14	2	1	0	1	2	19
	Grain Size	14	2	0	0	0	0	16

Notes:
[1]Field duplicates are collected at a frequency of 1 per 10.
[2]Field blanks are collected at a frequency of 1 per source per event (1 per week of sampling).
[3]Trip blanks are shipped with samples submitted for volatiles analysis. Trip blanks are used to monitor contamination that could be introduced during transportation. Trip blanks are collected at a frequency of 1 per cooler of volatiles samples.
[4]Matrix spike/matrix spike duplicates (MS/MSD) are collected at a frequency of 1 per 20. MS/MSDs represent samples for which extra volume must be collected for the laboratory to perform required QC analyses. Triple the normal volumes will be collected for all analyses.
[5]Equipment blanks are collected at a frequency of 1 every other day.
Note: This table is based on Navy Level D QA/QC requirements.

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Field Quality Control Procedures

Quality control duplicate samples and blanks are used to provide a measure of the internal consistency of the samples and to provide an estimate of the components of variance and the bias in the analytical process. Table 10-1 in the QAPP provides a summary of the collection frequencies of the field QC samples.

Blanks

Blanks provide a measure of cross-contamination sources, decontamination efficiency, and other potential errors that can be introduced from sources other than the sample. ASTM Type II water will be used for blanks. Three types of blanks will be generated during sampling activities: trip blanks, field blanks, and equipment blanks.

One trip blank will be included for each cooler containing samples for VOC analysis. The trip blanks will be prepared prior to each sampling event, shipped or transported to the field with the sampling bottles, and sent to the laboratory unopened for analysis. Trip blanks will not be prepared or handled in the field. Trip blanks will indicate if any contamination occurred during shipment to the field, field storage, or during shipment from the field to the analytical laboratory.

One field blank will be collected each week of sampling. The field blanks will indicate if any contaminants were introduced during the handling of the sample containers in the field or during sample analysis at the laboratory. The sample container will be filled with ASTM Type II water in the field at the time of sampling. The blank sample container is capped, packed, and shipped with the samples.

One equipment blank will be collected and analyzed every day during sampling activities. The equipment blanks will indicate the efficiency of equipment decontamination procedures.

Duplicates

Field duplicate samples will be collected at a frequency of 1 per 10 field samples per matrix. The location from which the duplicates are taken will be randomly selected. The duplicate sample will be submitted for analysis as two independent samples. These samples will be numbered non-sequentially.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Matrix spike/matrix spike duplicate (MS/MSD) samples will be collected at a frequency of one per 20 field samples. Analytical results of these samples indicate the impact the matrix (surface water or sediment) has on extracting the analyte for analysis. Data validators will use these results to evaluate the accuracy of the analytical data.

Section 3

Sample Designation

Each sample will be designated by an alphanumeric code that will identify the Norfolk Naval Base, Site number, and matrix sampled and contain a sequential sample number. Site-specific procedures are elaborated below.

The Norfolk Naval Base code will be NNB. Location types will be identified by a two-letter code and each sampling location will be identified with a two-digit number corresponding to the sampling location.

The following is a general guide for sample identification.

First Segment of Sample Designation		Second Segment of Sample Designation	
Norfolk Naval Base Code	**Investigation Code**	**Sample Type**	**Sample Location**
AAA	AAA	AA	NNA

Symbol Definition:

A = Alphabetic

N = Numeric

Base Code

NNB = Norfolk Naval Base

Investigation Code:

BCM = Bousch Creek Monitoring

Sample Type:

SD = Sediment Sample

SW = Surface Water Sample

TB = Trip Blank

EB = Equipment Blank

FB = Field Blank

Sample Location:

NNA = Unique sample location identifier and designation of low (L) tide or high (H) tide for surface water samples.

Sample Shipping Procedures

Strict adherence to both personnel and equipment decontamination procedures will help ensure the safety of onsite workers as well as the acquisition of quality data.

All field sampling activities will be documented through the use of field logs and chain-of-custody procedures. Sample containers will be clean, first-quality containers provided by the contracted laboratory. A complete listing of the types of bottles and preservatives to be used is given in Tables 2-1 and 2-3 in Section 2 of this FSP. An identification label will be attached to each sample container indicating the sample number, station number, analysis to be performed, preservative used, date and time of sample collection, and the name of the responsible sampling team member.

After collection, samples will be packed in coolers with vermiculite (and ice, if necessary) for shipment to the contracted laboratory via an overnight courier. Chain-of-custody forms will be taped to the inside of the lid of each cooler. Chain-of-custody forms contain general information about the location of the activity and the members of the sampling team, as well as specific information about the type of sample, sample location, number of sample containers from each station, and analyses to be performed. Each time the sample is relinquished or received, the party involved signs the form and indicates the time and date.

The coolers used to deliver the samples will be sealed with strapping tape. Evidence tape will be placed across the front and back of each lid to control tampering. The samples will be shipped to the laboratory at the end of each day of sampling to ensure that holding times are not exceeded.

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Field Sampling Plan

Appendix A

List of Standard Operating Procedures

SOP pH	Field Measurement of pH
SOP CondTemp	Field Measurement of Specific Conductance and Temperature
SOP DO	Field Measurement of Dissolved Oxygen
SOP Decon	Decontamination
SOP Homog	Homogenization of Soil and Sediment Samples
SOP VOC-Aq	VOC Sampling - Water
SOP SurfaceW	Surface Water Sampling
SOP SedSamp	Sediment Sampling

SOP pH: FIELD MEASUREMENT OF pH

I. PURPOSE

To provide a general guideline for field measurement of pH.

II. SCOPE

Standard field pH determination techniques for use on groundwater samples.

III. EQUIPMENT AND MATERIALS

- pH buffer solution for pH 4, 7, and 10
- Deionized water in squirt bottle
- pH meter
- Combination electrodes
- Beakers
- Glassware that has been washed with soap and water, rinsed twice with hot water, and rinsed twice with deionized water

IV. PROCEDURES AND GUIDELINES

A. CALIBRATION

Calibrate unit prior to initial daily use and at least once every 4 hours or every five samples, whichever is less. Calibrate with at least two solutions. Clean probe according to manufacturer's recommendations. Duplicate samples should be run once every 10 samples or every 4 hours.

1. Place electrode in pH 7 buffer solution.
2. Allow meter to stabilize and then turn calibration dial until a reading of 7.0 is obtained.
3. Rinse electrode with deionized water and place it in a pH 4 or pH 10 buffer solution.
4. Allow meter to stabilize again and then turn slope adjustment dial until a reading of 4.0 is obtained for the pH 4 buffer solution or 10.0 for the pH 10 buffer solution.

5. Rinse electrode with deionized water and place in pH 7 buffer. If meter reading is not 7.0, repeat sequence.

B. PROCEDURE

1. Before going out into the field:

   a) Check batteries.

   b) Do a quick calibration at pH 7 and 4 to check electrode.

   c) Obtain fresh solutions.

2. Calibrate meter using calibration procedure.

3. Pour the sample into a clean beaker.

4. Rinse electrode with deionized water between samples.

5. Immerse electrode in solution. Make sure the white KCl junction on the side of the electrode is in the solution. The level of electrode solution should be one inch above sample to be measured.

6. Recheck calibration with pH 7 buffer solution after every five samples.

C. GENERAL

1. When calibrating the meter, use pH buffers 4 and 7 for samples with pH <8, and buffers 7 and 10 for samples with pH >8. If meter will not read pH 4 or 10, something may be wrong with the electrode.

2. Measurement of pH is temperature dependent. Therefore, buffers temperatures should be within about 2 degrees C of sample temperatures. For refrigerated or cool samples, use refrigerated buffers to calibrate the pH meter.

3. Weak organic and inorganic salts and oil and grease interfere with pH measurements. If oil and grease are visible, note it on the data sheet. Clean electrode with soap and water and rinse with distilled water. Then recalibrate meter.

4. Following field measurements:

   a) Report any problems.
   b) Compare with previous data.
   c) Clean all dirt off meter and inside case.
   d) Store electrode in pH 4 buffer.

5. Accuracy and precision are dependent on the instrument used; refer to manufacturer's manual. Expected accuracy and precision are +/- 0.1 pH unit.

V. KEY CHECKS AND ITEMS

- Check batteries
- Calibrate

VI. PREVENTIVE MAINTENANCE

- Refer to operation manual for recommended maintenance.
- Check batteries, have a replacement set on hand.

SOP CondTemp: Field Measurement of Specific Conductance and Temperature

I. PURPOSE AND SCOPE

The purpose of this procedure is to provide a general guideline for field measurement of specific conductivity and temperature of groundwater samples.

II. EQUIPMENT AND MATERIALS

- Conductivity meter and electrode
- Distilled water in squirt bottle
- Standard potassium chloride (KCl) solution (0.01 N)

III. PROCEDURES AND GUIDELINES

A. Technical: Detection limit = 1 umho/cm @ 25°C; range = 0.1 to 100,000 umho/cm

B. Calibration: Calibrate prior to initial daily use with standard solution. The standards should have different orders of conductance. Clean probe according to manufacturer's recommendations. Duplicates should be run once every 10 samples. Calibration procedure:

1. With mode switch in OFF position, check meter zero. If not zeroed, set with zero adjust.
2. Plug probe into jack on side of meter.
3. Turn mode switch to red line and turn red line knob until needle aligns with red line on dial. If they cannot be aligned, change the batteries.
4. Immerse probe in 0.01 N standard KCl solution. Do not allow the probe to touch the sample container.
5. Set the mode control to TEMPERATURE. Record the temperature on the bottom scale of the meter in degrees C.
6. Turn the mode switch to appropriate conductivity scale (i.e., x100, x10, or x1). Use a scale that will give a midrange output on the meter.

7. Wait for the needle to stabilize. Multiply reading by scale setting and record the conductivity.

8. If the conductivity meter does not perform an automatic temperature adjustment, the conductivity may be adjusted to 25°C using the formula:

$$G_{25} = G_T / [1 + 0.02 (T - 25)]$$

Where:

G_{25} = conductivity at 25°C, umho/cm
T = temperature of sample, degrees C
G_T = conductivity of sample at temperature T, umho/cm

The table below lists the values of conductivity that the calibration solution would have if the distilled water were totally nonconductive; however, even water of high purity will possess a small amount of conductivity.

Temperature °C	Conductivity (umho/cm)
15	1,141.5
16	1,167.5
17	1,193.6
18	1,219.9
19	1,246.4
20	1,273.0
21	1,299.7
22	1,326.6
23	1,353.6
24	1,380.8
25	1,408.1
26	1,436.5
27	1,463.2
28	1,490.9
29	1,518.7
30	1,546.7

9. Rinse the probe with deionized water.

C. **Sample Measurement:** Pour the sample into a small beaker and place the probe in the sample. Note and record the reading. Rinse the probe with deionized water when done.

IV. ATTACHMENTS

- Conductivity meter calibration sheet

V. KEY CHECKS AND PREVENTATIVE MAINTENANCE

- Check battery.
- Calibrate meter.
- Clean probe with deionized water when done.
- When reading results, note sensitivity settings.
- Refer to operations manual for recommended maintenance.
- Check batteries, and have a replacement set on hand.

CONDUCTIVITY METER CALIBRATION SHEET

Date	Time	Analyst Initials	Instrument Readings: Uncalibrated @ EC=225	Instrument Readings: Calibrated @ EC=225	Comments

SOP DO: Field Measurement of Dissolved Oxygen

I. PURPOSE

To provide general guidelines for the calibration and use of the Dissolved Oxygen (DO) meter.

II. SCOPE

This is a general guideline for the field use of a DO meter. For specific instructions, refer to the operations manual.

III. EQUIPMENT AND MATERIALS

- Operations manual
- A DO probe and readout/control unit with batteries
- Electrolyte solution (KCl dissolved in deionized water) and probe membrane

IV. PROCEDURES AND GUIDELINES

A. Calibration

Calibrate prior to initial daily use before any readings are taken. Clean probe according to manufacturer's recommendations.

1. Prepare DO probe according to manufacturer's recommended procedures using electrolyte solution.

2. In the off position, set the pointer to zero using the screw in the center of the meter panel.

3. Turn function switch to red line and adjust using red line knob until the meter needle aligns with red mark at the 31 degrees C position.

4. Turn function switch to zero and adjust to zero using the zero control knob.

5. Attach prepared probe and adjust retaining ring finger tight.

6. Allow 15 minutes for optimum probe stabilization (when meter is off or during disconnection of the probe).

7. Place probe in hollow stopper that is supplied for use with the YSI Calibration Chamber.

8. Place approximately 1/2 inch of deionized water into a 4-ounce, wide mouth screw cap bottle. Keep this bottle capped and with the DO meter.

9. Just before use, shake the bottle to saturate the water with air.

10. Remove cap, place probe in bottle keeping an air-tight seal around the rubber stopper. Swirl water around in the bottle while waiting for conditions to reach equilibrium.

11. Shield chamber from sun and wind to avoid temperature fluctuations during calibration.

12. Turn function switch to temperature and record temperature reading. Determine calibration factor for that temperature and altitude correction factor from tables supplied by manufacturer.

13. Multiply the calibration factor by the correction factor to get a corrected calibration value.

14. Turn function switch to appropriate ppm range and adjust the calibrate knob until the meter reads the corrected calibration value. Wait two minutes to verify calibration value. Re-adjust as necessary.

B. Procedure

1. Before going out into the field:

   a) Check batteries
   b) Obtain fresh electrolyte solution
   c) Prepare DO probe

2. Calibrate meter using calibration procedure.

3. Place probe in water to be measured. The probe should be moved through the water at 1 ft/sec or use a probe with a built-in stirrer.

4. Allow sufficient time for probe to stabilize to water temperature and DO. Record DO meter reading.

V. ATTACHMENTS

None.

VI. KEY CHECKS AND ITEMS

- Battery check
- Calibration

VII. PREVENTIVE MAINTENANCE

- Refer to operation manual for recommended maintenance.
- Check batteries, have replacement set on hand.

DO METER
CALIBRATION SHEET

Date	Time	Analyst's Signature	Temp (C)	Alt. (ft)	Predict (ppm 0_2)	Actual (ppm 0_2)	Comment

SOP Decon: DECONTAMINATION

I. PURPOSE

To provide general guidelines for the decontamination of personnel, sampling equipment, and monitoring equipment used in potentially contaminated environments.

II. SCOPE

This is a general description of decontamination procedures.

III. EQUIPMENT AND MATERIALS

- Demonstrated analyte-free, deionized ("DI") water (ASTM Type II water)
- Distilled water
- Potable water (must be from a municipal water supplier, otherwise a priority pollutant +40 analysis must be run)
- 2.5% (W/W) trisodium phosphate ("TSP") and water solution
- Concentrated (V/V) pesticide grade methanol or hexane (DO NOT USE ACETONE)
- 10% (V/V) nitric acid (HNO_3) and water solution (only ultrapure grade HNO_3 is to be used)
- Large plastic pails or tubs for TSP and water, scrub brushes, squirt bottles for TSP, methanol and water, plastic bags and sheets
- DOT approved 55-gallon drum for disposal of waste
- Phthalate-free gloves
- Decontamination pad and steam cleaner/high pressure cleaner for large equipment

IV. PROCEDURES AND GUIDELINES

A. PERSONNEL DECONTAMINATION

To be performed after completion of tasks whenever potential for contamination exists, and upon leaving the exclusion zone.

1. Wash boots in TSP solution, then rinse with water. If disposable latex booties are worn over boots in the work area, rinse with TSP solution, remove, and discard into DOT approved 55-gallon drum.

2. Wash outer gloves in TSP solution, rinse, remove, and discard into DOT approved 55-gallon drum.

3. Remove disposable coveralls ("Tyveks") and discard into approved 55-gallon drum.

4. Remove respirator (if worn).

5. Remove inner gloves and discard.

6. At the end of the work day, shower entire body, including hair, either at the work site or at home.

7. Sanitize respirator if worn.

B. SAMPLING EQUIPMENT DECONTAMINATION

Reuseable sampling equipment is decontaminated after each use as follows.

1. Don phthalate-free gloves.

2. Prior to entering the potentially contaminated zone, wrap soil contact points in aluminum foil (shiny side out).

3. Rinse and scrub with potable water.

4. Wash all equipment surfaces that contacted the potentially contaminated soil/water with TSP solution.

5. Rinse with potable water.

6. Rinse with 10% HNO_3 solution when sampling for inorganics (carbon split spoons will be rinsed with a 1% solution).

7. Rinse with distilled or potable water and methanol or hexane solution (DO NOT USE ACETONE).

8. Air dry.

9. Rinse with deionized water.

10. Completely air dry and wrap exposed areas with aluminum foil (shiny side out) for transport and handling if equipment will not be used immediately.

11. Collect all rinsate and dispose of in a DOT approved 55-gallon drum.

C. HEALTH AND SAFETY MONITORING EQUIPMENT DECONTAMINATION

1. Before use, wrap soil contact points in plastic to reduce need for subsequent cleaning.

2. Wipe all surfaces that had possible contact with contaminated materials with a paper towel wet with TSP solution, then a towel wet with methanol solution, and finally three times with a towel wet with distilled water. Dispose of all used paper towels in a DOT approved 55-gallon drum.

D. SAMPLE CONTAINER DECONTAMINATION

The outsides of sample bottles or containers filled in the field must be decontaminated before being packed for shipment or handled by personnel without hand protection.

1. Wipe container with a paper towel dampened with TSP solution or immerse in the solution AFTER THE CONTAINERS HAVE BEEN SEALED. Repeat the above steps using potable water.

2. Dispose of all used paper towels in a DOT approved 55-gallon drum.

E. HEAVY EQUIPMENT AND TOOLS

Heavy equipment such as drilling rigs, drilling rods/tools, and the backhoe will be decontaminated upon arrival at the site and between locations as follows:

1. Set up a decontamination pad in area designated by Navy

2. Steam clean heavy equipment until no visible signs of dirt are observed. This may require wire or stiff brushes to dislodge dirt from some areas.

V. ATTACHMENTS

None.

VI. KEY CHECKS AND ITEMS

- Clean with solutions of TSP, methanol (or isopropanol) and distilled water.
- Do not use acetone for decontamination.
- Drum all contaminated rinsate and materials.
- Decontaminate filled sample bottles before relinquishing them to anyone.

decon.doc

SOP Homog:

HOMOGENIZATION OF SOIL AND SEDIMENT SAMPLES

I. PURPOSE

The homogenization of soil and sediment samples is performed to minimize any bias of sample representativeness introduced by the natural stratification of constituents within the sample.

II. SCOPE

Standard techniques for soil and sediment homogenization and equipment are provided in this SOP. These procedures do not apply to aliquots collected for TCL VOCs or field GC screening.

III. EQUIPMENT AND MATERIALS

Sample containers, stainless steel spoons or spatulas, and stainless steel pans.

IV. PROCEDURES AND GUIDELINES

Soil and sediment samples to be analyzed for semivolatiles, pesticides, PCBs, metals, cyanide, or field XRF screening should be homogenized in the field. After a sample is taken, a stainless steel spatula should be used to remove the sample from the split spoon or other sampling device. The sampler should not use fingers to do this, as gloves may introduce organic interferences into the sample.

Samples for VOCs should be taken immediately upon opening the spoon and should not be homogenized.

Prior to homogenizing the soil or sediment sample, any rocks, twigs, leaves, or other debris should be removed from the sample. The sample should be placed in a decontaminated stainless steel pan and thoroughly mixed using a stainless steel spoon. The soil or sediment material in the pan should be scraped from the sides, corners, and bottom, rolled into the middle of the pan, and initially mixed. The sample should then be quartered and moved to the four corners of the pan. Each quarter of the sample should be mixed individually, and then rolled to the center of the pan and mixed with the entire sample again.

All stainless steel spoons, spatulas, and pans must be decontaminated following procedures specified in SOP Decon prior to homogenizing the sample. A composite equipment rinse blank of homogenization equipment should be taken each day it is used.

SOP VOC-Aq: VOC Sampling—Water

To provide general guidelines for sampling aqueous volatile organic compounds.

II. SCOPE

Standard techniques for collecting representative samples are summarized. Site specific details are discussed in the FSP.

III. EQUIPMENT AND MATERIALS

- Sample vials, clean latex or surgical gloves, pII meter
- Hydrochloric acid (HCl) for preservation
- pH meter or pH indicating paper
- Surgical or latex gloves

IV. PROCEDURES AND GUIDELINES

1. Sample VOCs before sampling other analyte groups.

2. When sampling for VOCs, especially residential wells, evaluate the area around the sampling point for possible sources of air contamination by VOCs. Products that may give off VOCs and possibly contaminate a sample include perfumes and cosmetics, skin applied pharmaceuticals, automotive products (gasoline, starting fluid, windshield deicers, carburetor cleaners, etc.) and household paint products (paint strippers, thinners, turpentine, etc.).

3. To check the amount of hydrochloric acid (HCl) that needs to be added at each location, fill a test vial (40 ml) with the water to be sampled, add one drop of hydrochloric acid (HCl), gently mix, and check the pH. Repeat this cycle (if necessary) until you reach a pH of 2, counting the number of drops of HCl required. DISCARD THE TEST VIAL and add an equal number of drops of HCl to each of the sample vials. Proceed to sample.

4. Keep the caps off the sample vials for as short a time as possible.

5. Wear clean latex or surgical gloves.

6. Fill the sample vial immediately, allowing the water stream to strike the inner wall of the vial to minimize formation of air bubbles. DO NOT RINSE THE SAMPLE VIALS BEFORE FILLING.

7. Fill the sample vial with a minimum of turbulence, until the water forms a positive meniscus at the brim.

8. Replace the cap by gently stetting it on the water meniscus. Tighten firmly, but DO NOT OVERTIGHTEN.

9. Invert the vial and tap it lightly. If you see air bubbles in the sample, do not add more sample. Use another vial to collect another sample. Repeat if necessary until you obtain a proper sample.

V. ATTACHMENTS

None.

VI. KEY CHECKS AND ITEMS

- Check for possible sources of contamination.
- Check pH.
- Fill slowly, with as little turbulence as possible.
- Check for air bubbles.

SOP SurfaceW: Surface Water Sampling

I. PURPOSE AND SCOPE

This procedure presents the techniques used in collecting surface water samples.

II. MATERIALS AND EQUIPMENT

Materials and equipment vary depending on type of sampling. More detail is found in the Field Sampling Plan.

- Open tube sampler
- Dip sampler
- Weighted bottle sampler
- Hand pump
- Kemmerer or Van Dorn sampler
- Depth-integrating sampler
- Sample containers
- Meters for specific conductance, temperature, pH, and dissolved oxygen

III. PROCEDURES AND GUIDELINES

Before surface water samples are taken, all sampler assemblies and sample containers are cleaned and decontaminated as described in SOP Decon. Methods for surface water sample collection are described below.

A. Manual Sampling

Surface water samples are collected manually by submerging a clean glass, stainless steel, or Teflon container into the water body. Samples may be collected at depth with a covered bottle that can be removed with a tripline. The most common sampler types are beakers, sealable bottles and jars, pond samplers, and weighted bottle samplers. Pond samplers have a fixed or telescoping pole attached to the sample container. Weighted bottle samplers are lowered below water surface, where the attached bottle is opened, allowed to fill, and pulled out of the water. When retrieved, the bottle is tightly capped and removed from the sampler assembly. Specific types of weighted bottle samplers include dissolved oxygen, Kemmerer, or Van Dorn, and are acceptable in most instances.

A sample is taken with the following specific steps:

1. The location and desired depth for water sampling are selected.

2. The sample site is approached from downstream in a manner that avoids disturbance of bottom sediments as much as possible. The sample bottle is gently submerged with the mouth pointed upstream and the bottle tilted slightly downstream. Bubbles and floating materials should be prevented from entering the bottle.

3. For weighted bottle samplers, the assembly is slowly lowered to the desired depth. The bottle stopper is unseated with a sharp tug and the bottle is allowed to fill until bubbles stop rising to the surface.

4. When the bottle is full, it is gently removed from the water. If sample transfer is required, it should be performed at this time.

IV. REFERENCES

None.

SOP SedSamp: SEDIMENT SAMPLING

I. PURPOSE

These general outlines describe the collection and handling of sediment samples during field operations.

II. SCOPE

The sediment sampling procedures described the equipment and techniques needed to collect representative sediment samples.

III. EQUIPMENT AND MATERIALS

- Sample collection device (hand corer, scoop, dredge, grab sampler, or other suitable device)
- Stainless steel spoon or spatula for media transfer
- Measuring tape
- Log book
- Personal protection equipment (rubber or latex gloves, boots, hip waders, etc.)
- Sample bottles

IV. PROCEDURES AND GUIDELINES

1. Field personnel will start downstream and work upstream to prevent contamination of unsampled areas.

2. Make a sketch of the sample area showing important nearby river features and permanent structures that can be used to locate the sample points on a map. Whenever possible, include measured distances from such identifying features. Also include depth and width of waterway, rate of flow, type and consistency of sediment, and point and depth of sample removal (along shore, mid-channel, etc).

3. Transfer sample into appropriate sample jars with a stainless steel spoon or utensil. The sampler's fingers should never touch the sediment since gloves may introduce organic interferences into the sample.

4. Samples for volatile organics should immediately be placed in jars. Rocks and other debris should be removed before placement in jars.

5. For channel sampling, be on the alert for submerged hazards (rocks, tree roots, drop-offs, loss silt and muck) which can make wading difficult.

6. Follow the site safety plan designed for the specific nature of the site's sampling activities and locations.

7. Decontaminate all sampling implements and protective clothing according to prescribed procedures.

V. ATTACHMENTS

None.

VI. KEY CHECKS AND ITEMS

- Start downstream, work upstream.
- Log exact locations using permanent features.
- Beware of hidden hazards.

Draft Final

Health and Safety Plan for the Post Remediation Ecological Monitoring Camp Allen Landfill

Norfolk Naval Base
Norfolk, Virginia

Prepared for

Department of the Navy
Atlantic Division
Naval Facilities Engineering Command

Contract No. N62470-95-D-6007
CTO-0011

August 1996

Prepared by

CH2M HILL
Federal Group, Ltd.
Herndon, Virginia

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CH2M HILL HEALTH AND SAFETY PLAN

(Reference CH2M HILL SOP 19, *Health and Safety Plans*)

This health and safety plan will be kept on the site during field activities and will be reviewed and updated as necessary. The plan adopts, by reference, the standards of practice (SOP) in the CH2M HILL *Corporate Health and Safety Program, Program and Training Manual*, and CH2M HILL's *Site safety Notebook* as appropriate. The site safety coordinator (SSC) is to be familiar with these SOPs and the content of this plan. Site personnel must sign Attachment 1. In addition, this plan adopts procedures in the work plan for the project.

1 PROJECT INFORMATION AND DESCRIPTION

CLIENT OR OWNER: Department of the Navy
Atlantic Division

PROJECT NO: 134363

CH2M HILL PROJECT MANAGER: Jack Robinson, P.G.

OFFICE: WDC

SITE NAME: Norfolk Naval Base

SITE ADDRESS: 1510 Gilbert Street
Norfolk, Virginia 23511-2699

DATE HEALTH AND SAFETY PLAN PREPARED: March 19, 1996

DATE(S) OF INITIAL VISIT: 3/11/96

DATE(S) OF SITE WORK:

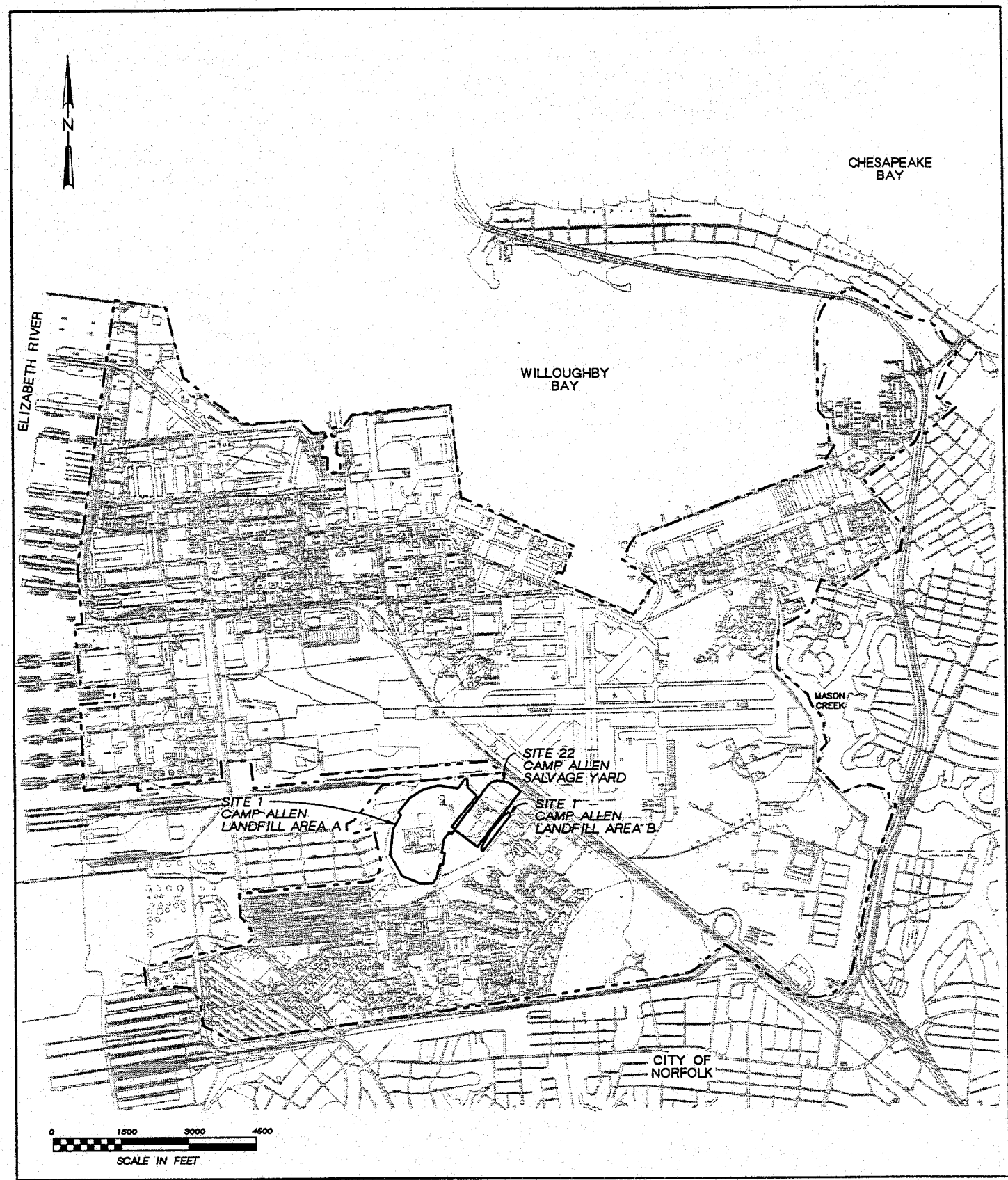
SITE ACCESS: All sites at the Norfolk Naval Base are accessed through the Main Gate of the Base.

SITE SIZE: Norfolk Naval Base is located on 4,631 acres of land directly northwest of the city of Norfolk, Virginia.

SITE TOPOGRAPHY: The facility is bounded on the north by Willoughby Bay, on the west by the junction of the Elizabeth River and the James River (forming the Hampton Roads), and on the south and east by the city of Norfolk. A portion of the east boundary of the facility is formed by Mason Creek (Figure 1-1). The Base includes approximately 4000 buildings and an airfield. The western portion of the Base is a developed waterfront area that contains piers and facilities for loading, unloading, and servicing naval vessels.

Land use surrounding Base is industrial and residential. The waterfront area south of the site provides shipping facilities for several large industries. Residential land use is located to the south and east of the Base. Willoughby Spit, a low-density residential area located northeast of Base, is also used for recreational activities.

PREVAILING WEATHER: The Norfolk region has a maritime climate which is characterized by long temperate summers and mild winters. The average annual temperature is 60.7 degrees Fahrenheit (F). July is the warmest month, with temperatures averaging 78.7 degrees F; while January is the coolest month, with temperatures averaging 43.1 degrees F. Freezing temperatures are infrequent in the region. Precipitation averages 43 inches annually and is evenly distributed throughout the year. A slight increase in precipitation occurs from June to August due to the prevalence of convective thunderstorms. The average annual snowfall is 8.8 inches. Winds are generally in the easterly direction and moderate, ranging from six to eleven knots.



LEGEND

PROPERTY BOUNDARY - NORFOLK NAVAL BASE

Figure 1-1
SITE LOCATION MAP
Norfolk Naval Base

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SITE DESCRIPTION AND HISTORY: Norfolk Naval Base began operations in 1917 when the U.S. Navy acquired 474 acres of land to develop a naval base to support World War I activities. Bulkheads were built along the coast to extend available land. After dredge and fill operations, the total land under Navy control was 792 acres.

An additional 143 acres of land were acquired in 1918 and officially commissioned for the Naval Air Station (NAS). From 1936 until 1940, improvements to the piers and expansion of supplies/materials handling facilities were completed.

During World War II (between 1940 and 1945) major construction projects were completed including a hospital, power plant, numerous runways and hangers, a tank farm, and several barracks/housing complexes. During this time the area of the Base expanded to over 2,100 acres due to U.S. involvement in World War II. After World War II, the Base continued to acquire land through various types of land transfers and dredge and fill operations conducted in areas of Mason Creek and Bousch Creek Basins and Willoughby Bay. During its history the Base has expanded to become the worlds largest naval installation. In 1995, the Base had 15 piers handling 3,100 ship movements annually.

2 PROJECT ORGANIZATION AND TASKS TO BE PERFORMED UNDER THIS PLAN

2.1 PROJECT ORGANIZATION

CLIENT: Department of the Navy
Atlantic Division
Naval Facilities Engineering Command

CH2M HILL:
Project Manager: Paul Nikituk
Field Team Leader: Don Martinson
Refer to Section 4 for field staff.

CONTRACTORS and SUBCONTRACTORS: Refer to Section 4.2.

2.2 DESCRIPTION OF TASKS (Reference Section 1, "Field Activity Start-up Form," of *Site Safety Notebook*

Refer to project documents (i.e., work plan) for detailed task information. A health and safety risk analysis has been performed for each task and is incorporated in this plan through task-specific hazard controls and requirements for monitoring and protection. Tasks in addition to those listed below require an approved amendment to this plan before additional work begins. Refer to Section 10.2 for procedures related to tasks that do not involve hazardous waste operations and emergency response (Hazwoper).

2.2.1 HAZWOPER-REGULATED TASKS

- Test pit and excavation
- Drilling
- Geoprobe boring
- Groundwater monitoring
- Aquifer testing
- Surface water sampling
- Sediment sampling
- Surface soil sampling
- Hand augering
- Surveying
- Investigation-derived waste (drum) sampling and disposal
- Observation of loading of material for offsite disposal
- Oversight of remediation and construction

2.2.2 NON-HAZWOPER-REGULATED TASKS

Under specific circumstances, the training and medical monitoring requirements of federal or state Hazwoper regulations are not applicable. It must be demonstrated that the tasks can be performed without the possibility of exposure in order to use non-Hazwoper-trained personnel. **Prior approval from the HSM is required before these tasks are conducted on regulated hazardous waste sites.**

TASK	RESTRICTIVE CONDITIONS
• Electrical installation	
• Iron work (installing rebar)	
• Masonry work	
• General heavy equipment work (excavation, grading, etc.)	
• Mechanical installations (equipment, pumps, etc.)	
• Engineering testing/evaluation	
• Building construction	

3 HAZARD EVALUATION AND CONTROL

3.1 HEAT AND COLD STRESS (Reference CH2M HILL SOP HS-09, *Heat and Cold Stress*)

3.1.1 PREVENTING HEAT STRESS

- Drink 16 ounces of water before beginning work, such as in the morning or after lunch. Disposable (e.g., 4-ounce) cups and water maintained at 50° to 60°F should be available. Under severe conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons per day. Take regular breaks in a cool, preferably air-conditioned, area. Do not use alcohol in place of water or other nonalcoholic fluids. Decrease your intake of coffee and caffeinated soft drinks during working hours. Monitor for signs of heat stress.
- Acclimate to site work conditions by slowly increasing workloads; e.g., do not begin site work with extremely demanding activities.
- Use cooling devices, such as cooling vests, to aid natural body ventilation. The devices add weight, so their use should be balanced against efficiency.
- Use mobile showers or hose-down facilities to reduce body temperature and cool protective clothing.
- During hot weather, conduct field activities in the early morning or evening if possible.
- Provide adequate shelter to protect personnel against radiant heat (sun, flames, hot metal), which can decrease physical efficiency and increase the probability of heat stress.
- In hot weather, rotate shifts of workers.
- Maintain good hygiene standards by frequently changing clothing and by showering. Clothing should be permitted to dry during rest periods. Persons who notice skin problems should consult medical personnel.

3.1.2 SYMPTOMS AND TREATMENT OF HEAT STRESS

	Heat Syncope	Heat Rash (*malaria rubra*, "prickly heat")	Heat Cramps	Heat Exhaustion	Heat Stroke
Signs and Symptoms	Sluggishness or fainting while standing erect or immobile in heat.	Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations during heat exposure.	Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours.	Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid thready pulse and low blood pressure; oral temperature normal or low	Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature.
Treatment	Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete.	Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.	Remove to cooler area. Rest lying down. Increase fluid intake.	Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.	Cool rapidly by soaking in cool– but not cold– water. Call ambulance, and get medical attention immediately!

3.1.3 HEAT-STRESS MONITORING

For field activities part of ongoing site work activities in hot weather, the following procedures should be used to monitor the body's physiological response to heat and to estimate the work-cycle/rest-cycle when workers are performing moderate levels of work. These procedures should be considered when the ambient air temperature exceeds 70°F, the relative humidity is high (>50%), when workers are wearing semi-impermeable or impermeable clothing, or when the workers exhibit symptoms of heat stress.

The heart rate should be measured by the radial pulse for 30 seconds, as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 110 beats/minute, or 20 beats/minute above resting pulse. If the HR is higher, the next work period should be shortened by 33 percent, while the length of the rest period stays the same. If the pulse rate still exceeds 110 beats/minute at the beginning of the next rest period, the following work cycle should be further shortened by 33 percent. The procedure is continued until the rate is maintained below 110 beats/minute, or 20 beats/minute above resting pulse. Additional methods of monitoring, such as taking oral temperatures, or weighing individuals before and after their shifts could also be included.

3.1.4 PREVENTING COLD STRESS

- Be aware of the symptoms of cold-related disorders, and ***wear proper clothing for the anticipated fieldwork.***
- Consider monitoring the work conditions and adjusting the work schedule, using guidelines developed by the U.S. Army (wind-chill index) and the National Safety Council (NSC).
- ***Wind-Chill Index.*** This measure relates the dry bulb temperature and the wind velocity. It is used only to estimate the combined effect of wind and low air temperatures on exposed skin. The wind-chill index sometimes is limited in its usefulness because the index does not take into account the body part that is exposed, the level of activity, or the amount or type of clothing worn. For those reasons, it is used only as a guideline to warn workers when they are in a situation that can cause cold-related illnesses. Used in conjunction with the NSC guidelines, the wind-chill index provides a starting point for adjusting work and warm-up schedules.
- ***NSC Guidelines for Work and Warm-Up Schedules.*** The cold-exposure limits recommended by the NSC can be used in conjunction with the wind-chill index to estimate work and warm-up schedules for fieldwork. The guidelines are not absolute; ***workers should be monitored for symptoms of cold-related illness.*** If symptoms are not observed, the work duration can be increased.
- The wind-chill index and the NSC guidelines are in the CH2M HILL *Corporate Health and Safety Program, Program and Training Manual,* SOP HS-09.

3.1.5 SYMPTOMS AND TREATMENT OF COLD STRESS

	Immersion (Trench) Foot	Frostbite	Hypothermia
Signs and Symptoms	Feet discolored and painful; infection and swelling present.	Blanched, white, waxy skin, but tissue resilient; tissue cold and pale.	Shivering, apathy, sleepiness; rapid drop in body temperature; glassy stare; slow pulse; slow respiration.
Treatment	Seek medical treatment immediately.	Remove victim to a warm place. Rewarm area quickly in warm–but **not** hot–water. Have victim drink warm fluids, but **not** coffee or alcohol. Do not break blisters. Elevate the injured area, and get medical attention.	Remove victim to a warm place. Have victim drink warm fluids, but **not** coffee or alcohol. Get medical attention.

3.2 PROCEDURES FOR LOCATING BURIED UTILITIES

Local Utility Mark-Out Service
Name: Mr. Bruce Davis–Public Works Department
Phone: (4) 4973 (on-base phone) or (804) 444-4973 (off-base phone)

- Where available, obtain utility diagrams for the facility.
- Review locations of sanitary and storm sewers, electrical conduits, water supply lines, natural-gas lines, and fuel tanks and lines.
- Review proposed locations of intrusive work with facility personnel knowledgeable of locations of utilities. Check locations against information from utility mark-out service.
- Where necessary, clear locations with a utility-locating instrument (e.g., metal detector).
- Where necessary (e.g., uncertainty about utility locations), excavation or drilling of the upper depth interval should be performed manually.
- Monitor for signs of utilities during advancement of intrusive work (e.g., sudden change in advancement of auger or split spoon).
- When the client or other onsite party is responsible for determining the presence and locations of buried utilities, the SSC should confirm that arrangement.

3.3 GENERAL PHYSICAL (SAFETY) HAZARDS AND CONTROLS

Engineering and administrative controls are to be implemented by the party in control of the site or the hazard (i.e., CH2M HILL, subcontractor, or contractor). CH2M HILL employees and subcontractors must, at a minimum, remain aware of hazards affecting them regardless of who is responsible for controlling the hazards. Specialty subcontractors are responsible for the safe operation of their equipment (e.g., drill rig, heavy equipment). CH2M HILL employees are not to operate, or assist in the operation of, any subcontractor or contractor equipment.

		Tasks									
Hazard (Refer to SOP, or HSP Section)	**Engineering Controls, Administrative Controls, and Work Practices**	**Test Pit and Excavation**	**Drilling, Geoprobe Installation, Well Installation and Abandonment**	**Groundwater Monitoring, Aquifer Testing, and Video Surveying of Wells**	**Surface Water and Sediment Sampling Using a Boat**	**Surface Water and Sediment Sampling from the Shore or Water**	**Hand Augering**	**Surveying**	**IDW Drum Sampling and Disposal***	**Observation of Loading of Material for Offsite Disposal**	**Remediation and Construction Oversight**
Flying debris/objects (HS-07)	Provide shielding and PPE; maintain distance.	X	X		X	X	X		X	X	X
Noise > 85 dBA	Noise protection and monitoring required.	X	X		X					X	X
Gas cylinders (HS-21)	Instruct employees in the safe use of compressed gases. Make certain gas cylinders are properly anchored and chained. Keep cylinders away from ignition sources. Cap cylinders when not in use.	X	X								
Electrical	• Make certain third wire is properly grounded. Do not tamper with electrical wiring unless qualified to do so. Ground as appropriate. • Project field sites should have ground fault circuit interrupters (GFCIs) installed for all wiring, including extension cords. • Heavy equipment (e.g., drill rig) should remain at least 15 feet from overhead power line for power lines of 50 kV or less. For each 10 kV > 50, increase distance by ½ foot. • Operate and maintain equipment according to manufacturer's instructions. • Use only extension cords that are three-wire grounded. Cords passing through work areas must be covered or elevated to protect from damage. • Use only electrical tools and equipment that are either effectively grounded or double-insulated UL approved. • Properly label switches, fuses, and circuit breakers. • Remove cord from an outlet by grasping the plug, not pulling the cord. • Protect all electrical equipment, tools, switches, etc., from elements. • Avoid physical contact with power circuit. • Only qualified electricians are to install and work on electrical circuits and equipment.	X	X	X	X						X
Suspended loads	Work not permitted under suspended loads.	X	X		X						
Buried utilities, drums, tanks, etc (Section 3.3)	Locate buried utilities, drums, tanks, etc., before digging or drilling and mark location.	X	X				X			X	X
											X
Slip, trip, fall hazards (e.g., wet/muddy surface, inadequate railing, unstable surface)	Provide slip-resistant surfaces, ropes, and/or other devices to be used. Brace and shore equipment	X	X	X	X	X	X	X	X	X	X
Back injury (HS-29)	Use proper lifting techniques, or provide mechanical lifting aids.	X	X	X	X	X	X		X		X
Confined space entry (Section 9.0)	Space must be evaluated by qualified person. Additional controls and monitoring, training, and an approved entry permit are generally required.	NOT APPROVED									
Trenches/excavations (HS-32)	Make certain trench meets OSHA standard before entering. All excavations > 4 feet deep must be sloped or shored, and have a ladder every 25 feet. Personnel and equipment must remain at least 2 feet from edge of trench at all times.	X									X
Protruding objects	Flag visible objects.	X	X	X	X	X	X	X	X	X	X
Visible lightning	Stop work.	X	X	X	X	X	X	X	X	X	X
Vehicle traffic (HS-24)	Provide temporary traffic controls, including trained flaggers and lookouts. Implement traffic control program when required.									X	X
Stairways, ladders, and scaffolds (HS-25)	Stairways and ladders are generally required when there is a break in elevation of 19 inches or more. Keep access ways clear. Equipment must meet OSHA specifications. Document employee training.		X								X
Elevated work area/falls (HS-31)	Provide guardrail, safety net, floor covers, body harness, and monitoring system, where applicable. Document employee training.	X				X					X
Fire prevention and control (HS-22)	• No spark sources are allowed within exclusion or decontamination zones. • Appropriate firefighting equipment must be available on the site. • Extinguishers are to be inspected visually every month and undergo an annual maintenance check. • Post "Exit" signs over exiting doors, and post "Fire Extinguisher" signs over extinguisher locations. Keep areas near exits and extinguishers clear. Open flames are prohibited in the vicinity of flammable materials. • Combustible materials stored outside should be at least 10 feet from the building. • Unnecessary combustible materials and flammable or combustible liquids must not be allowed to accumulate. • Flammable or combustible liquids must be kept in approved containers, and must be stored in an approved storage cabinet.	X	X			X			X		X

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		Tasks									
Hazard (Refer to SOP, or HSP Section)	**Engineering Controls, Administrative Controls, and Work Practices**	**Test Pit and Excavation**	**Drilling, Geoprobe *Installation*, Well Installation and Abandonment**	**Groundwater Monitoring, Aquifer Testing, and Video Surveying of Wells**	**Surface Water and Sediment Sampling Using a Boat**	**Surface Water and Sediment Sampling from the Shore or Water**	**Hand Augering**	**Surveying**	**IDW Drum Sampling and Disposal***	**Observation of Loading of Material for Offsite Disposal**	**Remediation and Construction Oversight**
Inadequate illumination	Site work will be performed during daylight hours whenever possible. Work conducted during hours of darkness will require enough illumination intensity "to read a newspaper without difficulty."	X	X	X	X	X	X	X	X	X	X
Entanglement in rotating equipment	• Prohibit loose clothing and hair • Prohibit wearing jewelry		X				X				
Drilling	• The drill rig is not to be operated in inclement weather. • The driller is to verify that the rig is properly leveled and stabilized before raising the mast. • Personnel should be cleared from the sides and rear of the rig before the mast is raised. • The driller is not to drive the rig with the mast in the raised position. • The driller must check for overhead power lines before raising the mast. A minimum distance of 15 feet between mast and overhead lines (<50 kV) is recommended. Increased separation may be required for lines greater than 50 kV. • Personnel should stand clear before rig startup. • The driller is to verify that the rig is in neutral when the operator is not at the controls. • Become familiar with the hazards associated with the drilling method used (cable tool, air rotary, hollow-stem auger, etc.). • Do not wear loose-fitting clothing, watches, etc., that could get caught in moving parts. • Do not smoke or permit other spark-producing equipment around the drill rig. • The drill rig must be equipped with a kill wire or switch, and personnel are to be informed of its location. • Be aware and stand clear of heavy objects that are hoisted overhead. • The driller is to verify that the rig is properly maintained in accordance with the *drilling company's maintenance program*. • The driller is to verify that all machine guards are in place while the rig is in operation. • The driller is responsible for housekeeping (maintaining a clean work area). • The drill rig should be equipped with at least one fire extinguisher. • If the drill rig comes into contact with electrical wires and becomes electrically energized, do not touch any part of the rig or any person in contact with the rig, and stay as far away as possible. Notify emergency personnel immediately.		X								
Heavy equipment	• Become familiar with hazards specific to the equipment being used. • Always confirm that the operator is aware of your location, particularly when you approach or pass by equipment. • Backup alarm is required for heavy equipment. Do not count on backup alarms always functioning. Look around when alarm sounds. • Do not ride equipment not designed for passengers. • Do not climb on operating equipment. • *Do not place yourself between fixed and moving parts or objects.* • Do not stand adjacent to the equipment. • Stay clear of equipment on cross slopes and unstable terrain. • Stay clear of pile-driving operations. • Stay outside the turning radius of the equipment. • Operators using all-terrain vehicles (ATV) must be trained; other ATV requirements may apply. • Observer must remain in contact with operator and signal safe backup. • Personnel must remain outside the *turning radius*.	X	X		X					X	X
Working near water	• U.S. Coast Guard-approved personal flotation devices (PFDs-e.g., life jacket) provided for each employee will be worn. • PFDs will be inspected before and after each use. Defective equipment will not be used. • Sampling and other equipment will be used according to the manufacturer's instructions. • A minimum of one life-saving skiff will be provided for emergency rescue. • A minimum of one ring buoy with 90 feet of 3/8-inch solid-braid polypropylene (or equal) rope will be provided for emergency rescue. • Keep nonessential personnel 3 feet from edge of water.					X					

3.3 GENERAL PHYSICAL (SAFETY) HAZARDS AND CONTROLS

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		Tasks									
Hazard (Refer to SOP, or HSP Section)	**Engineering Controls, Administrative Controls, and Work Practices**	**Test Pit and Excavation**	**Drilling, Geoprobe Installation, Well Installation and Abandonment**	**Groundwater Monitoring , Aquifer Testing, and Video Surveying of Wells**	**Surface Water and Sediment Sampling Using a Boat**	**Surface Water and Sediment Sampling from the Shore or Water**	**Hand Augering**	**Surveying**	**IDW Drum Sampling and Disposal***	**Observation of Loading of Material for Offsite Disposal**	**Remediation and Construction Oversight**
Working on water	• Safe means of boarding or leaving a boat or a platform will be provided to prevent slipping and falling. Boat/barge must be equipped with adequate railing. • Instructions/warnings (e.g., protect from pinch points, sharp objects, rope burns/entanglement). • Work requiring the use of a boat will take place only during daylight hours. • Work requiring the use of a boat will not take place during inclement weather. • The boat/barge must be operated according to U.S. Coast Guard regulations (speed, lightning, right-of-way, etc.). Shut off engine before refueling; do not smoke while refueling.				X						
IDW Drum sampling	Personnel are allowed to handle and/or sample drums containing investigation-derived waste (IDW) only; handling or sampling other drums requires a plan revision or amendment approved by the CH2M HILL HSM. The following control measures will be taken when sampling drums containing IDW: • Minimize transportation of drums. • Minimize number of people involved in the actual sampling. • Sample only labeled drums or drums known to contain IDW. • Use caution when sampling bulging or swollen drums. Relieve pressure slowly. • If drums contain, or potentially contain, flammable materials, use nonsparking tools to open. • Picks, chisels, and firearms may not be used to open drums. • Reseal bung holes or plugs whenever possible. • Avoid mixing incompatible drum contents. • Sample drums without leaning over the drum opening. • If there is evidence of contamination on the lid of the drum, cover the lid with plastic sheeting. • Transfer the content of drums using a method that minimizes contact with material. • Air monitoring and PPE requirements specified in sections 5 and 6 must address drum sampling. • Spill-containment procedures specified in Section 8 must be appropriate for the material to be handled.								X		

3.4 BIOLOGICAL HAZARDS AND CONTROLS

Hazard and Location	Control Measures
Snakes typically are found in underbrush and tall grassy areas.	If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area. If a person is bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Seek medical attention immediately. **DO NOT** apply ice, cut the wound, or apply a tourniquet. Carry the victim or have him/her walk slowly if the victim must be moved. Try to identify the type of snake: note color, size, patterns, and markings.
Poison ivy, poison oak, and poison sumac typically are found in brush or wooded areas. They are more commonly found in moist areas or along the edges of wooded areas.	Become familiar with the identity of these plants. Wear protective clothing that covers exposed skin and clothes. Avoid contact with plants and the outside of protective clothing. If skin contacts a plant, wash the area with soap and water immediately. If the reaction is severe or worsens, seek medical attention.
Exposure to **bloodborne pathogens** may occur when rendering first aid or CPR, or when coming into contact with medical or other potentially infectious material, or when coming into contact with landfill waste or waste streams containing such infectious material.	Training is required before a task involving potential exposure is performed. Exposure controls and personal protective equipment (PPE) are required as specified in CH2M HILL SOP HS-36, *Bloodborne Pathogens*. Hepatitis B vaccination must be offered before the person participates in a task where exposure is a possibility.
Bees and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic.	Watch for and avoid nests. Keep exposed skin to a minimum. Carry a kit if you have had allergic reactions in the past, and inform the SSC and/or the buddy. If a stinger is present, remove it carefully with tweezers. Wash and disinfect the wound, cover it, and apply ice. Watch for allergic reaction; seek medical attention if a reaction develops.

Other Potential Biological Hazards:

None known

3.5 TICK BITES (Reference CH2M HILL HS-03, *Tick Bites*)

Ticks typically are in wooded areas, bushes, tall grass, and brush. Ticks are black, black and red, or brown and can be up to one-quarter inch in size.

Prevention against tick bites includes avoiding tick areas; wearing tightly woven light-colored clothing with long sleeves and wearing pant legs tucked into boots or socks; spraying **only outside** of clothing with insect repellent containing permethrin or permanone, and spraying skin with DEET; and checking yourself frequently for ticks and showering as soon as possible. To prevent chemical repellents from interfering with sample analyses, exercise care while using repellents during the collection and handling of environmental samples.

If bitten by a tick, carefully remove the tick with tweezers, grasping the tick as close as possible to the point of attachment while being careful not to crush the tick. After removing the tick, wash your hands and disinfect and press the bite area. The removed tick should be saved. Report the bite to human resources personnel.

Look for symptoms of Lyme disease or Rocky Mountain spotted fever (RMSF). Lyme: a rash that looks like a bullseye with a small welt in the center. RMSF: a rash of red spots under the skin 3 to 10 days after the tick bite. In both cases, chills, fever, headache, fatigue, stiff neck, bone pain may develop. If symptoms appear, seek medical attention.

3.6 RADIOLOGICAL HAZARDS AND CONTROLS

Refer to CH2M HILL's *Corporate Health and Safety Program, Program and Training Manual*, and *Corporate Health and Safety Program, Radiation Protection Program Manual,* for standards of practice for operating in contaminated areas.

Hazards	Controls
None Known	None Required

3.7 HAZARDS POSED BY CHEMICALS BROUGHT ON THE SITE

3.7.1 HAZARD COMMUNICATION

(Reference CH2M HILL *Hazard Communication Manual* and Section 5 of the *Site Safety Notebook*)

CH2M HILL's *Hazard Communication Program Manual,* which is available from area or regional offices and from the Corporate Human Resources Department in Denver. The project manager is to request Material Safety Data Sheets (MSDSs) from the client or from the contractors and the subcontractors for chemicals to which CH2M HILL employees potentially are exposed. The SSC is to do the following:

- Give employees required site-specific HAZCOM training.
- Confirm that the inventory of chemicals brought on the site by subcontractors is available.
- Before or as the chemicals arrive on the site, obtain an MSDS for each hazardous chemical.
- Label chemical containers with the identity of the chemical and with hazard warnings, if any.

The chemical products listed below will be used on the site. Refer to Attachment 2 for MSDSs.

Chemical	Quantity	Location
Methane (calibration gas)	1 liter, compressed gas	Support Zone
Isobutylene (calibration gas)	1 liter, compressed gas	Support Zone
Pentane (calibration gas)	1 liter, compressed gas	Support Zone
Hydrochloric Acid (sample preservative)	< 500 ml	Support/Exclusion Zone
Nitric Acid (sample preservative)	< 500 ml	Support/Exclusion Zone
Sulfuric Acid (sample preservative)	< 500 ml	Support/Exclusion Zone
Sodium Hydroxide (sample preservative)	< 500 ml	Support/Exclusion Zone
Methanol (decontamination solvent)	< 1 gallon	Support/Decontamination Zone
Hexane (decontamination solvent)	< 1 gallon	Support/Decontamination Zone
Isopropanol (decontamination solvent)	< 1 gallon	Support/Decontamination Zone
pH Buffers (calibration standard)	< 500 ml	Support Zone
MSA Sanitizer (respirator cleaner)	< 1 liter, powder	Support/Decontamination Zone
Alconox/Liquinox (detergent)	< 1 liter, powder/liquid	Support/Decontamination Zone

3.7.2 SHIPPING AND TRANSPORTATION OF CHEMICAL PRODUCTS

(Reference CH2M HILL's *Procedures for Shipping and Transporting Dangerous Goods*)

Nearly all chemicals brought to the site are considered hazardous materials by the U.S. Department of Transportation (DOT). All staff who ship the materials or transport them by road must receive the CH2M HILL training in shipping dangerous goods. All hazardous materials that are shipped (e.g., via Federal Express) or are transported by road must be properly identified, labeled, packed, and documented by trained staff. Contact the HSM or the Equipment Coordinator for additional information.

3.8 CONTAMINANTS OF CONCERN (REFER TO PROJECT FILES FOR MORE-DETAILED CONTAMINANT INFORMATION)

Contaminant	Location and Highest[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
No previous investigations known.	NA	NA	NA	NA	

3.9 POTENTIAL ROUTES OF EXPOSURE

DERMAL: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 5.	**INHALATION:** Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in sections 5 and 6, respectively.	**OTHER:** Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before eating, drinking, or smoking).

4 PERSONNEL

4.1 CH2M HILL EMPLOYEE MEDICAL SURVEILLANCE AND TRAINING

(Reference CH2M HILL SOP HS-01, *Medical Surveillance*, and HS-02, *Health and Safety Training*)

The employees listed below are enrolled in the CH2M HILL Comprehensive Health and Safety Program and meet state and federal hazardous waste operations requirements for 40-hour initial training, 3-day on-the-job experience, and 8-hour annual refresher training. Employees designated "SSC" have received 8 hours of supervisor and instrument training and can serve as site safety coordinator (SSC) for the level of protection indicated. An SSC with a level designation (D, C, B) equal to or greater than the level of protection being used must be present during all tasks performed in exclusion or decontamination zones that involve the potential for exposure to health and safety hazards. Employees designated "FA-CPR" are currently certified by the American Red Cross, or equivalent, in first aid and CPR. At least one FA-CPR designated employee must be present during all tasks performed in exclusion or decontamination zones that involve the potential for exposure to health and safety hazards. The employees listed below are currently active in a medical surveillance program that meets state and federal regulatory requirements for hazardous waste operations. The CH2M HILL medical surveillance program is performed under the direct supervision of a licensed physician who is Board Certified in the practice of Occupational Medicine (see Section 13). Certain tasks (e.g., confined-space entry) and contaminants (e.g., lead) may require additional training and medical monitoring.

Pregnant employees are to be informed of and are to follow the procedures in CH2M HILL's SOP HS-04, *Reproduction Protection*, including obtaining a physician's statement of the employee's ability to perform hazardous activities, before being assigned fieldwork.

Employee Name	Office	Responsibility	SSC/FA-CPR
Don Martinson	WDC	Field Team Leader	Level B SSC; FA-CPR
Linnea Eng	WDC	Field Team Leader	Level D SSC; FA-CPR

4.2.1 CLIENT

Contact Name:	Mr. David Forsythe, NTR
Phone:	(804) 322-4783
Facility Contact Name:	Ms. Sharon Waligora, Environmental Coordinator
Phone:	(804) 444-3009
	Mr. William Whitmire, Hazardous Waste Dispatch
	(804) 444-7528
	Mr. Merrill Ashcraft, Navy On-Science Coordinator
	(804) 445-8851

4.2.2 CH2M HILL

Project Manager:	Paul Nikituk (703) 471-1441
Health and Safety Manager:	John Longo (201) 316-9300
Field Team Leader:	Don Martinson (703) 471-1441
Site Safety Coordinator:	Don Martinson (703) 471-1441

The SSC is responsible for contacting the field team leader and the project manager. In general, the project manager either will contact or will identify the client contact. The Health and Safety Manager (HSM) should be contacted as appropriate. The SSC or the project manager must notify the client and the HSM when a serious injury or a death occurs or when health and safety inspections by OSHA or other agencies are conducted. Refer to sections 10 through 12 for emergency procedures and phone numbers.

4.2.3 SUBCONTRACTORS

(Reference Section 3, *Corporate Health and Safety Program Manual*)

When specified in the project documents (e.g., contract), this plan may cover CH2M HILL subcontractors. However, this plan does not address hazards associated with tasks and equipment that the subcontractor has expertise in (e.g., operation of drill rig). Specialty subcontractors are responsible for health and safety procedures and plans specific to their work. Specialty subcontractors are to submit plans to CH2M HILL for review and approval before the start of fieldwork. Subcontractors must comply with the established health and safety plan(s). CH2M HILL must monitor and enforce compliance with the established plan(s).

Subcontractor: No subcontractor required to complete the activities covered under this HASP.
Subcontractor Contact:
Telephone:

General health and safety communication with subcontractors contracted with CH2M HILL and covered by this plan is to be conducted as follows:

- Request that the subcontractor, if a specialty subcontractor, submit a safety or health plan applicable to their expertise (e.g., drill-rig safety plan or nuclear density gauge [NDG] health plan); attach the reviewed plan.
- Supply subcontractors with a copy of this plan, and brief them on its provisions.
- Direct health and safety communication to the subcontractor-designated safety representative.
- Notify the subcontractor-designated representative if a violation of the plan(s) is observed. Specialty subcontractors are responsible for mitigating hazards in which they have expertise.
- If a hazard condition persists, inform the subcontractor. If the hazard is not mitigated, stop affected work as a last resort and notify the project manager.
- When an apparent imminent danger exists, promptly remove all affected personnel. Notify the project manager.
- Make clear that consistent violations of the health and safety plan by a subcontractor may result in termination of the subcontract.

4.2.4 CONTRACTORS

(Reference Section 3, *Corporate Health and Safety Program Manual*)

This plan does not cover contractors that are contracted directly to the client or the owner. CH2M HILL is not responsible for directing contractor personnel and is not to assume responsibility through their actions. When the contractor is in control of the site, ask the contractor to conduct a briefing of their health and safety practices and to describe how they apply to CH2M HILL's activities. Request a copy of the contractor's health and safety plan.

Contractor: No subcontractors required to complete the activities covered under this HASP.
Contact Name: NA
Telephone: NA

General health and safety communication with contractors *not* contracted with CH2M HILL is listed below. These procedures can also be applied to other third party communications (e.g., client personnel).

- Ask the contractor to brief CH2M HILL on the contractor's health and safety plan for how the plan affects CH2M HILL employees on the site.
- If acceptable to the client, communicate about health and safety directly with the contractor PM or other onsite contractor-designated representative. CH2M HILL employees are not to direct the details of the contractor's work or to advise on health and safety (e.g., how the contractor corrects unsafe conditions).
- If an observed hazard poses a risk to CH2M HILL personnel, notify the party controlling the work activity as soon as possible. Notify the project manager; the project manager will notify the client. Document oral notification in project records (i.e., the field logbook).
- If a hazardous condition endangering a CH2M HILL employee persists, inform the contractor and the project manager (the project manager will contact the client) that CH2M HILL cannot execute the assigned work until the hazard is mitigated.
- When an apparent imminent danger exists, orally warn the person(s) in danger and orally notify the contractor promptly. When an imminent danger involves a CH2M HILL employee, remove the employee and suspend CH2M HILL work immediately until the hazard has been mitigated. Inform the project manager and the contractor promptly.
- The SSC or the project manager must notify the client and CH2M HILL health and safety staff when (1) the contractor fails to remedy an unsafe condition affecting CH2M HILL personnel, (2) the contractor does not remedy the hazardous condition within a reasonable period of time, or (3) the contractor repeatedly creates the hazardous condition.

5 PERSONAL PROTECTIVE EQUIPMENT (PPE) (Reference CH2M HILL SOP HS-07, *Personal Protective Equipment*, HS-08, *Respiratory Protection*, Section 2 of the *Site Safety Notebook*)

5.1 PPE SPECIFICATIONS[a]

Task	Level	Body	Head	Respirator[b]
General work uniform when no chemical exposure is anticipated	D	Work clothes; steel-toe, steel-shank leather work boots; work gloves	Hardhat[c] Safety glasses Ear protection[d]	None required
Monitoring well installation and all sampling activities.	Modified D	**COVERALLS:** Uncoated Tyvek® **BOOTS:** Steel-toe, steel-shank chemical-resistant boots OR steel-toe, steel-shank leather work boots with outer rubber boot covers **GLOVES:** Inner surgical-style nitrile glove AND outer chemical-resistant nitrile glove.	Hardhat[c] Splash shield[c] Safety glasses Ear protection[d]	None required
Monitoring well installation and all sampling activities if Action Levels in Table 6 "Air Monitoring Specifications" are exceeded.	C	**COVERALLS:** Polycoated Tyvek® **BOOTS:** Steel-toe, steel-shank chemical-resistant boots OR steel-toe, steel-shank leather work boots with outer rubber boot covers **GLOVES:** Inner surgical-style nitrile glove AND outer chemical-resistant nitrile glove.	Hardhat[c] Splash shield[c] Ear protection[d] Spectacle inserts	APR, full face, MSA Ultratwin or equivalent; with GME-H[e] cartridges or equivalent
None anticipated	B	**COVERALLS:** Polycoated Tyvek® **BOOTS:** Steel toe, steel-shank chemical-resistant boots OR steel-toe, steel-shank leather work boots with outer rubber boot covers **GLOVES:** Inner surgical-style nitrile glove AND outer chemical-resistant nitrile glove.	Hardhat[c] Splash shield[c] Ear protection[d] Spectacle inserts	Positive-pressure demand self-contained breathing apparatus (SCBA): MSA Ultralite, or equivalent

[a] Modifications are as indicated. CH2M HILL will provide PPE to only CH2M HILL employees.
[b] No facial hair that would interfere with respirator fit is permitted.
[c] Hardhat and splash-shield areas are to determined by the SSC.
[d] Ear protection should be worn while working around drill rigs or other noise-producing equipment or when conversations cannot be held at distances of 3 feet or less without shouting. Refer to Section 6 for other requirements.
[e] The GME-H cartridge is the new standard-issue cartridge. Available stock of the previously standard GMC-H cartridges may be used for tasks covered by this plan.

5.2 REASONS FOR UPGRADING OR DOWNGRADING LEVEL OF PROTECTION

Upgrade*	Downgrade
• Request from individual performing task. • Change in work task that will increase contact or potential contact with hazardous materials. • Occurrence or likely occurrence of gas or vapor emission. • Known or suspected presence of dermal hazards. • Instrument action levels (Section 6) exceeded.	• New information indicating that situation is less hazardous than originally thought. • Change in site conditions that decreases the hazard. • Change in work task that will reduce contact with hazardous materials.

*Performing a task that requires an upgrade to a higher level of protection (e.g., level D to level C) is permitted only when the PPE requirements have been specified in Section 5 and an SSC who meets the requirements specified in subsection 4.1 is present.

6 AIR MONITORING SPECIFICATIONS (Reference CH2M HILL SOP HS-06, *Air Monitoring*, and Section 2 of the *Site Safety Notebook*)

Instrument	Tasks	Action Levels[a]		Frequency[b]	Calibration
PID: OVM with 10.6eV lamp or equivalent	Monitoring well installation, soil, and groundwater sampling activities.	0 - 5 ppm 5 - 10 ppm > 10 ppm	Level D Level C Level B (not anticipated)	Initially and periodically during task	Daily; before and after each period of use
CGI: MSA model 260 or 261 or equivalent	Drilling	0-10%[c] LEL: 10-25%[c] LEL: >25%[c] LEL:	No explosion hazard Potential explosion hazard Explosion hazard; evacuate or vent	Continuous during advancement of boring or trench	Daily; before and after each period of use
O_2 Meter: MSA model 260 or 261 or equivalent	Drilling	>25.0%[c] O_2: 20.9%[c] O_2: <19.5%[c] O_2:	Explosion hazard; evacuate or vent Normal O_2 O_2 deficient; vent or use SCBA	Continuous during advancement of boring or trench	Daily; before and after each period of use
Dust Monitor: Miniram model PDM-3 or equivalent	Dust-generating activities (visible dust in the breathing zone)	0 - 1 mg/m^3 >1 - 5 mg/m^3 >5 mg/m^3	Level D Level C Stop work; implement dust suppression measures	Initially and periodically during task	Zero Daily; before and after each period of use
Noise-Level Monitor[e]:	None anticipated	< 85 dB(A) 85 - 120 dB(A) 120 dB(A)	No action required Hearing protection required[f] Stop; re-evaluate	Initially and periodically during task	Daily; before and after each period of use

Note a: Action levels apply to sustained breathing-zone measurements above background.

Note b: The exact frequency of monitoring depends on field conditions and is to be determined by the SSC; generally, every 5 to 15 minutes is acceptable; more frequently may be appropriate. Monitoring results should be recorded. Documentation should include instrument and calibration information, time and measurement result, personnel monitored, and place/location where measurement is taken (e.g., "Breathing Zone/MW-3," "at surface/SB-2," etc.).

Note c: If the measured percent of O_2 is less than 10, an accurate LEL reading will not be obtained. Percent LEL and percent O_2 action levels apply to only ambient working atmospheres, and do not apply to confined-space entry. More-stringent percent LEL and O_2 action levels are required for confined-space entry; refer to Section 9.

Note d: Refer to SOP HS-10 for instructions and documentation on radiation monitoring and screening.

Note e: Contact HSM. Noise monitoring, training, and audiometric testing also are required.

6.1 CALIBRATION SPECIFICATIONS

(Refer to the respective manufacturer's instructions for proper instrument-maintenance procedures)

Instrument	Gas	Span	Reading	Method
PID: HNU, 10.2 eV probe	100 ppm isobutylene	9.8 ± 2.0	55 ppm	1.5 lpm reg T-tubing OR 0.25 lpm reg direct tubing
HNU, 11.7 eV probe		5.0 ± 2.0	68 ppm	
PID: OVM, 10.0 or 10.6 eV bulb	100 ppm isobutylene	RF = 0.55	55 ppm	1.5 lpm reg T-tubing
OVM, 11.8 eV bulb		RF = 0.68	68 ppm	
PID: MiniRAE, 10.6 eV bulb	100 ppm isobutylene	CF=53	53 ppm ±5 ppm	1.5 lpm REG T-Tubing
PID: TVA 1000	100 ppm isobutylene	CF=0.55	55 ppm ± 5 ppm	1.5 lpm REG T-Tubing
FID: OVA-128	100 ppm methane	3.0 ± 1.5	100 ppm	1.5 lpm reg T-tubing
FID: TVA 1000	100 ppm methane	CF=1.00	100 ppm ± 10	1.5 lpm reg T-tubing
Dust Monitor: Miniram-PDM3	Dust-free air	Not applicable	0.00 mg/m^3 in "Measure" mode	Dust-free area OR Z-bag with HEPA filter
CGI: MSA 260, 261, 360, or 361	0.75% pentane	N/A	50% LEL ± 5 % LEL	1.5 lpm reg direct tubing

6.2 AIR SAMPLING

Sampling may be required by other OSHA regulations where there may be exposure to certain contaminants. Air sampling typically is required when site contaminants include lead, cadmium, arsenic, asbestos, and certain volatile organic compounds. Contact the HSM immediately if these contaminants are encountered.

Method Description: Not applicable

Personnel and Areas

Results must be sent immediately to the HSM. Regulations may require reporting to monitored personnel. Results reported to:

HSM: John Longo/NJO
Other:

7 DECONTAMINATION (REFERENCE CH2M HILL SOP HS-13, *DECONTAMINATION*)

The SSC must monitor the effectiveness of the decontamination procedures. Decontamination procedures found to be ineffective will be modified by the SSC.

7.1 DECONTAMINATION SPECIFICATIONS

Personnel

- Boot wash/rinse
- Glove wash/rinse
- Outer-glove removal
- Body-suit removal
- Inner-glove removal
- Respirator removal
- Hand wash/rinse
- Face wash/rinse
- Shower ASAP
- **PPE-disposal method:**
- **Water-disposal method:**

Sample Equipment

- Wash/rinse equipment
- Solvent-rinse equipment
- **Solvent-disposal method:**

Heavy Equipment

- Power wash
- Steam clean
- **Water-disposal method:**

7.2 DIAGRAM OF PERSONNEL-DECONTAMINATION LINE

No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SSC should establish areas for eating, drinking, and smoking. Contact lenses are not permitted in exclusion or decontamination zones.

Figure 7-1 illustrates a typical establishment of work zones, including the decontamination line. Work zones are to be modified by the SSC to accommodate task-specific requirements.

8 SPILL-CONTAINMENT PROCEDURES

Sorbent material will be maintained in the support zone. Incidental spills will be contained with sorbent and will be disposed of properly.

9 CONFINED-SPACE ENTRY

(Reference CH2M HILL SOP HS-17, *Confined Space Entry*)

No confined-space entry will be permitted. Confined-space entry requires additional health and safety procedures, training, and a permit. If conditions change such that confined-space entry is necessary, contact the HSM to develop the required entry permit.

When planned activities will not include confined-space entry, permit-required confined spaces accessible to CH2M HILL personnel are to be identified before the task begins. The SSC is to confirm that permit spaces are properly posted or that employees are informed of their locations and informed of their hazards.

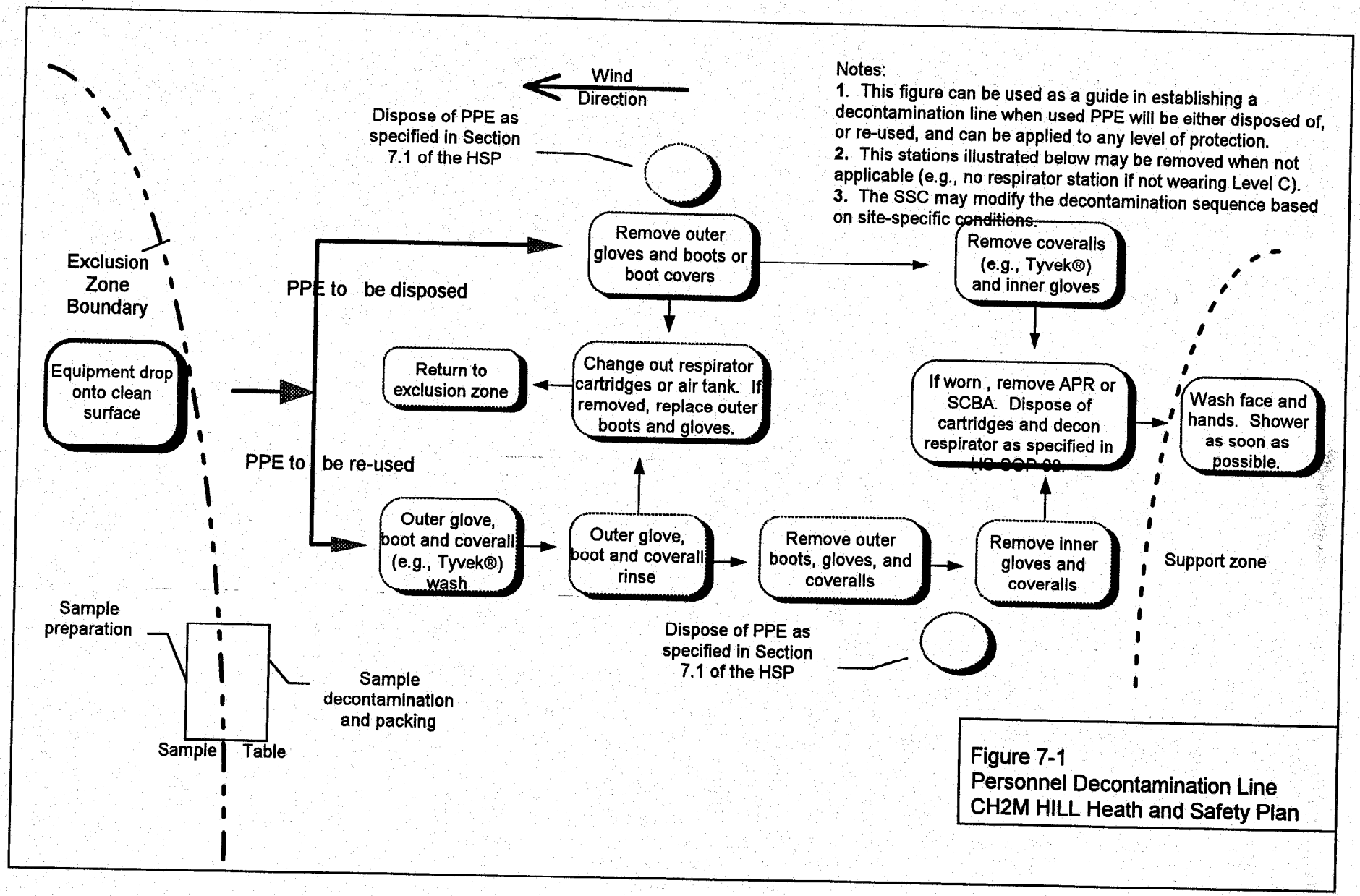


Figure 7-1
Personnel Decontamination Line
CH2M HILL Heath and Safety Plan

10 SITE-CONTROL PLAN

10.1 SITE-CONTROL PROCEDURES

- The site safety coordinator (SSC) will conduct a site safety briefing (see below) before starting field activities or as tasks and site conditions change.
- Topics for briefing on site safety: general discussion of health and safety plan, site-specific hazards, locations of work zones, PPE requirements, equipment, special procedures, emergencies. Refer to Section 8 of *Site Safety Notebook.*
- The SSC records attendance at safety briefings in a logbook and documents the topics discussed.
- The SSC will ensure that a daily log-in and log-out book is maintained for all personnel entering the site.
- Post the OSHA job-site poster in a central and conspicuous location at sites where project field offices, trailers, or equipment storage boxes are established. Posters can be obtained by calling either 800/548-4776 or 800/999-9111.
- Field Trailers: Post "Exit" signs above exit doors, and post "Fire Extinguisher" signs above locations of extinguishers. Keep areas near exits and extinguishers clear.
- Determine wind direction.
- Establish work zones: support, decontamination, and exclusion zones. Delineate work zones with flags or cones as appropriate. Support zone should be upwind of the site.
- Establish decontamination procedures, including respirator-decontamination procedures, and test the procedures.
- Use access control at the entry and exit from each work zone.
- Store chemicals in appropriate containers.
- Make MSDSs available for onsite chemicals to which employees are exposed.
- Establish onsite communication consisting of the following:
  - Line-of-sight and hand signals
  - Air horn
  - Two-way radio or cellular telephone if available
- Establish offsite communication.
- Establish and maintain the "buddy system."
- Establish procedures for disposing of material generated on the site.
- Initial air monitoring is conducted by the SSC in appropriate level of protection.
- The SSC is to conduct periodic inspections of work practices to determine the effectiveness of this plan -- refer to CH2M HILL SOP 18, *Health and Safety* Checklist, or Section 4 of *Site Safety Notebook.* Deficiencies are to be noted, reported to the HSM, and corrected.

10.2 HAZWOPER COMPLIANCE PLAN (Reference CH2M HILL SOP HS-17, *Health and Safety Plans*)

This section outlines procedures to be followed when certain activities do not require 24- or 40-hour training. ***Note, prior approval from the HSM is required before these tasks are conducted on regulated hazardous waste sites.***

- Certain parts of the site work may be covered by state or federal Hazwoper standards and therefore require training and medical monitoring. Anticipated tasks must be included in subsection 2.2.1.
- Air sampling must confirm that there is no exposure to gases or vapors before non-Hazwoper-trained personnel are allowed on the site. Other data (e.g., soil) also must document that there is no potential for exposure. The HSM must approve the interpretation of these data. Refer to subsections 3.8 and 6.2 for contaminant data and air sampling requirements, respectively.
- Non-Hazwoper-trained personnel must be informed of the nature of the existing contamination and its locations, the limits of their access, and the emergency action plan for the site. Non-Hazwoper-trained personnel also must be trained in accordance with all other state and federal OSHA requirements, including 29 CFR 1910.1200 (HAZCOM). Refer to subsection 3.7.1 for hazard communication requirements.
- Air monitoring with direct-reading instruments conducted during regulated tasks also should be used to ensure that non-Hazwoper-trained personnel (e.g., in an adjacent area) are not exposed to volatile contaminants. Non-Hazwoper-trained personnel should be monitored whenever the belief is that there may be a possibility of exposure (e.g., change in site conditions), or at some reasonable frequency to confirm that there is no exposure. Refer to Section 6.1 for air monitoring requirements.
- Treatment system start-ups: Once a treatment system begins to pump and treat contaminated media, the site is, for the purposes of applying the Hazwoper standard, considered a treatment, storage, and disposal facility (TSDF). Therefore, once the system begins operation, only Hazwoper-trained personnel (minimum of 24 hours of training) will be permitted to enter the site. All non-Hazwoper-trained personnel must leave the site.

If Hazwoper-regulated tasks are conducted concurrently with nonregulated tasks, non-Hazwoper-trained subcontractors must be removed from areas of exposure. If non-Hazwoper-trained personnel remain on the site while a Hazwoper-regulated task is conducted, the contaminant/exposure area (exclusion zone) must be posted, non-Hazwoper-trained personnel must be reminded of the locations of restricted areas and the limits of their access, and real-time monitoring must be conducted. Non-Hazwoper-trained personnel at risk of exposure must be removed from the site until it can be demonstrated that there is no longer a potential for exposure to health and safety hazards.

11 EMERGENCY RESPONSE PLAN (REFERENCE CH2M HILL SOP HS-12, *EMERGENCY RESPONSE*)

11.1 PRE-EMERGENCY PLANNING

The SSC performs the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with the facility and local emergency-service providers as appropriate.

- Review the facility emergency and contingency plans where applicable.
- Locate the nearest telephone; determine what onsite communication equipment is available (e.g., two-way radio, air horn).
- Identify and communicate chemical, safety, radiological, and biological hazards.
- Confirm and post emergency telephone numbers, evacuation routes, assembly areas, and route to hospital; communicate the information to onsite personnel.
- Post site map marked with locations of emergency equipment and supplies, and post OSHA job-site poster. The OSHA job-site poster is required at sites where project field offices, trailers, or equipment-storage boxes are established. Posters can be obtained by calling either 800/548-4776 or 800/999-9111.
- Field Trailers: Post "Exit" signs above exit doors, and post "Fire Extinguisher" signs above locations of extinguishers. Keep areas near exits and extinguishers clear.
- Review changed site conditions, onsite operations, and personnel availability in relation to emergency response procedures.
- Evaluate capabilities of local response teams where applicable.
- Where appropriate and acceptable to the client, inform emergency room and ambulance and emergency response teams of anticipated types of site emergencies.
- Designate one vehicle as the emergency vehicle; place hospital directions and map inside; keep keys in ignition during field activities.
- Inventory and check site emergency equipment, supplies, and potable water.
- Communicate emergency procedures for personnel injury, exposures, fires, explosions, chemical and vapor releases.
- Review notification procedures for contacting CH2M HILL's medical consultant and team member's occupational physician.
- Rehearse the emergency response plan once before site activities begin, including driving the route to the hospital.
- The emergency response plan will be periodically exercised and critiqued.
- Brief new workers on the emergency response plan.
- The SSC will evaluate emergency response actions and initiate appropriate follow-up actions.

11.2 EMERGENCY EQUIPMENT AND SUPPLIES

The SSC should mark the locations of emergency equipment on the site map and should post the map.

Emergency Equipment and Supplies	Location
20-lb (or two 10-lb) fire extinguisher (A, B, and C classes)	CH2M HILL Field Vehicle
First aid kit	CH2M HILL Field Vehicle
Eye wash*	CH2M HILL Field Vehicle
Potable water	CH2M HILL Field Vehicle
Bloodborne-pathogen kit	CH2M HILL Field Vehicle
Additional equipment (specify)	None anticipated

*When applicable, the emergency eye wash unit must meet the American National Standards Institute (ANSI) criteria (ANSI Standard Z358.1-1990 or later) and be capable of delivering 1.5 liters (0.4 gallons) per minute of potable water to the eyes for fifteen minutes.

11.3 EMERGENCY MEDICAL TREATMENT

- Notify appropriate emergency response authorities listed in sections 12 and 13 (e.g., 911).
- During a time of no emergency, contact CH2M HILL's medical consultant for advice and guidance on medical treatment.
- The SSC will assume charge during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room.
- Prevent further injury.
- Initiate first aid and CPR where feasible.
- Get medical attention immediately.
- Perform decontamination where feasible, and to the extent possible; lifesaving and first aid or medical treatment take priority. Decontamination procedures may need to be postponed, but should be implemented as soon as possible after the victim is stabilized.
- Notify the field team leader and the project manager of the injury.
- Make certain that the injured person is accompanied to the emergency room.
- Notify the health and safety manager.
- Notify the injured person's human resources department within 24 hours.
- Prepare an incident report -- refer to CH2M HILL SOP 12, *Emergency Response and First Aid*, and Section 6 of *Site Safety Notebook*. Submit the report to the corporate director of health and safety and the corporate human resources department (COR) within 48 hours.
- When contacting the medical consultant, state that you are calling about a CH2M HILL matter, and give your name, your telephone number, the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.

11. 4 NONEMERGENCY PROCEDURES

The procedures listed above may be applied to nonemergency incidents. Injuries and illnesses (including overexposure to contaminants) must be reported to Human Resources. If there is doubt about whether medical treatment is necessary, or if the injured person is reluctant to accept medical treatment, contact the CH2M HILL medical consultant.

- When contacting the medical consultant, state that the situation is a CH2M HILL matter, and give your name, your telephone number, the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.
- Follow these procedures as appropriate.

11.5 INCIDENT RESPONSE

In fires, explosions, or chemical releases, actions to be taken include the following:

- Shut down CH2M HILL operations and evacuate the immediate work area.
- Account for personnel at the designated assembly area(s).
- Notify appropriate response personnel.
- Assess the need for site evacuation, and evacuate the site as warranted.

Instead of implementing a work-area evacuation, note that small fires or spills posing minimal safety or health hazards may be controlled.

11.6 EVACUATION

- Evacuation routes will be designated by the SSC before work begins.
- Onsite and offsite assembly points will be designated before work begins.
- Personnel will leave the exclusion zone and assemble at the onsite assembly point upon hearing the emergency signal for evacuation.
- Personnel will assemble at the offsite point upon hearing the emergency signal for a site evacuation.
- The SSC and a "buddy" will remain on the site after the site has been evacuated (if possible) to assist local responders and advise them of the nature and location of the incident.
- The SSC accounts for all personnel in the onsite assembly zone.
- A person designated by the SSC before work begins will account for personnel at the offsite assembly area.
- The SSC will write up the incident as soon as possible after it occurs and will submit a report to the corporate director of health and safety.

11.7 EVACUATION ROUTES AND ASSEMBLY POINTS

Refer to the site map in Section 1. Evacuation routes and assembly areas (and alternative routes and assembly areas) are specified on the site map.

11.8 EVACUATION SIGNALS

Signal	Meaning
Grasping throat with hand	Emergency–help me.
Thumbs up	OK; understood.
Grasping buddy's wrist	Leave area now.
Continuous sounding of horn	Emergency; leave site now.

Client/Facility: No site-specific signals applicable

12 EMERGENCY RESPONSE

12.1 EMERGENCY RESPONSE TELEPHONE NUMBERS

SITE ADDRESS: Norfolk Naval Base Norfolk, Virginia	**Phone:** **Cellular Phone:**
Security (NAVBASE): Response Operator	**Phone:** (4) 2324 or (804) 444-2324 (4) 2737 or (804) 444-2737
Fire: Security (HAS): Mr. Frank King	**Phone:** (4) 3333 or (804) 444-3333
Ambulance: (Sewell Point) (Public)	**Phone:** (4) 2674 or (804) 444-2674 (9) 911 or 911
Public Works Department (Utility Clearances): Mr. Bruce Davis	**Phone:** (4) 4973 or (804) 444-4973
Emergency: (one call)	**Phone:** (4) 0716 or 0720, or 911
Hazardous Waste Dispatcher: Mr. William Whitmire	**Phone:** (4) 7528 or (804) 444-7528
COMNAVBASE Duty Desk**	**Phone:** (804) 322-2866/67
Regional Poison Control Center, Richmond	**Phone:** 1-800-552-6337

*When using a cellular phone outside the telephone's normal calling area, exercise caution in relying on the cellular phone to activate 911. When the caller is outside the normal calling area, the cellular service carrier should connect the caller with emergency services in the area where the call originated, but this may not occur. Telephone numbers of backup emergency services should be provided if a cellular phone is relied on to activate 911.

** All spills must be reported to the COMNAVBASE Duty Desk

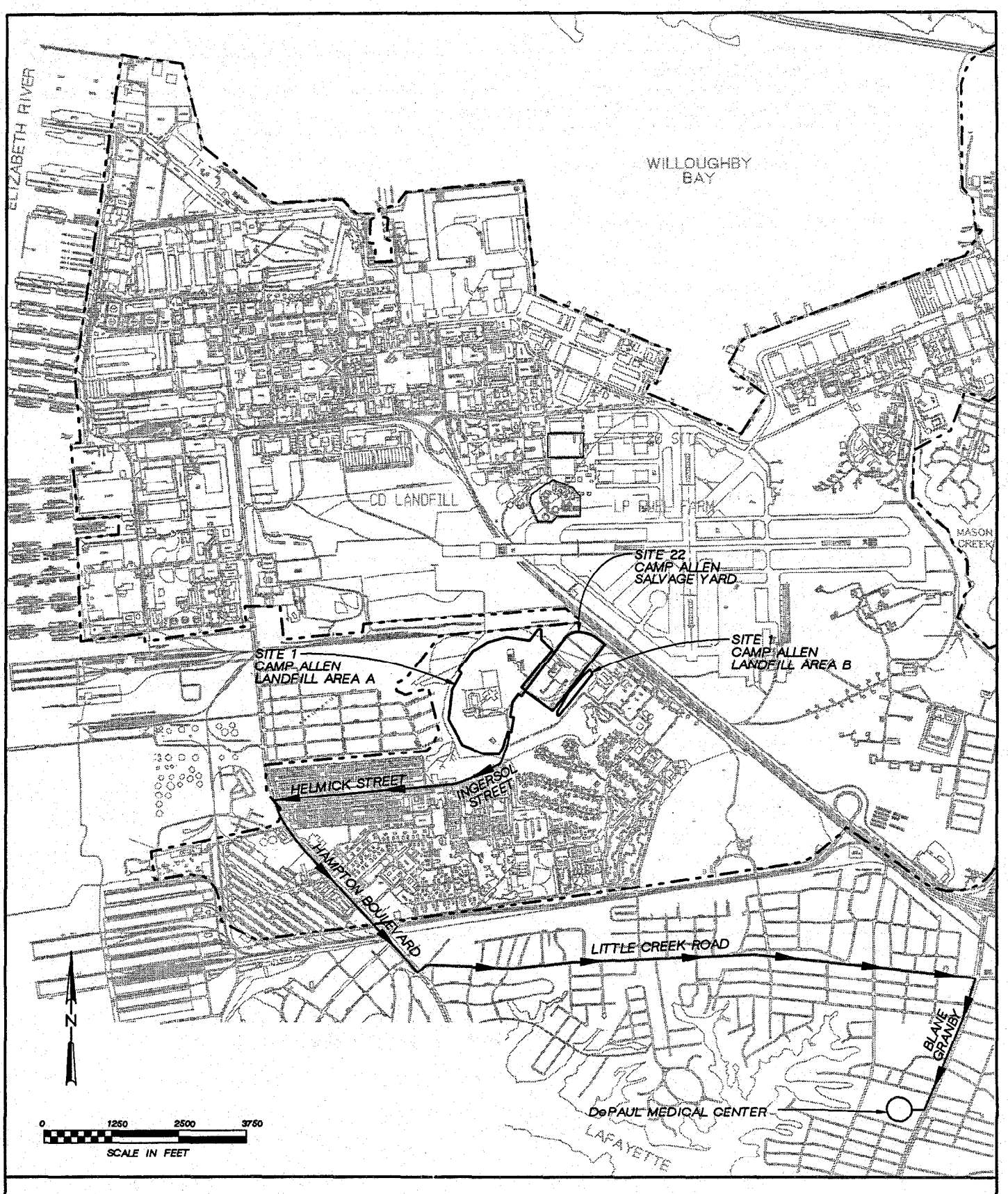
Hospital: DePaul Medical Center **Address:** 150 Kingsley Lane, Norfolk, VA	**Phone:** (9) 889-5111 or (804) 889-5111 (emergency room)

Route to Hospital: (Refer to Figure 12-1) - Depends on location within base area

12.2 GOVERNMENT AGENCIES INVOLVED IN PROJECT

Federal Agency and Contact Name: **Phone:**	Department of the Navy, Atlantic Division Mr. David Forsythe, NTR (804) 322-4783
State Agency and Contact Name: **Phone:**	Not assigned
Local Agency and contact Name: **Phone:**	Not assigned

Contact the project manager. Generally, the project manager will contact relevant government agencies.



LEGEND

PROPERTY BOUNDARY - NORFOLK NAVAL BASE

ROUTE TO HOSPITAL

Figure 12-1
ROUTE TO HOSPITAL
Naval Base, Norfolk

CH2MHILL

09-AUG-1996 4363f007.dlv

13 EMERGENCY CONTACTS

If an injury occurs, notify the injured person's personnel office as soon as possible after obtaining medical attention for the injured person. Notification **MUST** be made within 24 hours of the injury.

CH2M HILL Medical Consultant

Dr. Elayne F. Theriault
Environmental Medical Resources, Inc.
Atlanta, Georgia
800/229-3674 OR 770/455-0818
(After-hours calls will be returned within 20 minutes.)

Occupational Physician (Regional or Local)

Dr. Laura Staton
46440 Benedict Drive, Suite 108
Sterling, Virginia 22170
(703) 444-5656

Corporate Director Health and Safety

Name: Mollie Netherland/SEA
Phone: 206/453-5005

Site Safety Coordinator (SSC)

Name: Jack Robinson/WDC
Phone: (703) 471-1441

Medical and Training Administrator

Name: Susan Rineholt/COR
Phone: 303/771-0900

Regional Manager

Name: Dick Bedard
Phone: (617) 723-9036

Health and Safety Manager (HSM)

Name: John Longo
Phone: (201) 316-9300

Project Manager

Name: Mike Tilchin
Phone: (703) 471-1441

Radiation Health Manager (RHM)

Name: Frank Petelka/ORO
Phone: 615/483-9032 (H)615/482-8667

Regional Human Resources Department

Name: Michelle Riley-Jones
Phone: (703) 471-1441

Client

Name: David Forsythe, NTR
Phone: (804) 322-4783

Corporate Human Resources Department

Name: Julie Zimmerman/COR
Phone: 303/771-0900

Federal Express Dangerous Goods Shipping

Phone: 800/238-5355

CH2M HILL Emergency Number for Shipping Dangerous Goods

Phone: 800/255-3924

Worker's Compensation and Auto Claims

GAB Business Services, Inc.
Phone: 800/747-7222 After hours 800/621-5410

Report fatalities AND report vehicular accidents involving pedestrians, motorcycles, or more than two cars.

14 APPROVAL

This site-specific health and safety plan has been written for use by CH2M HILL only. CH2M HILL claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if those conditions change.

14.1 ORIGINAL PLAN

WRITTEN BY: Don Martinson **DATE:** 4-1-96

APPROVED BY: **DATE:**

14.2 REVISIONS

REVISIONS MADE BY: **DATE:**

REVISIONS TO PLAN:

REVISIONS APPROVED BY: **DATE:**

15 DISTRIBUTION

Name	Office	Responsibility	Number of Copies
Jerri McCauslin	COR	Senior Program Assistant	1
John Longo	NJO	Health and Safety Manager/Approver	1
Mike Tilchin	WDC	Project Manager	1
Don Martinson	WDC	Field Team Leader/Field Team	
Don Martinson	WDC	Site Safety Coordinator	1
Client	NA	Client Project manager	

16 ATTACHMENTS

Attachment 1: Employee Signoff
Attachment 2: Applicable Material Safety Data Sheets

Attachment 1
Employee Signoff

EMPLOYEE SIGNOFF

The employees listed below have been given a copy of this health and safety plan, have read and understood it, and agree to abide by its provisions.

EMPLOYEE NAME	EMPLOYEE SIGNATURE AND DATE

133236.PM.PO/D1/13/wdc.dlw

Draft Final

Investigation Derived Waste Management Plan for the Post Remediation Ecological Monitoring Camp Allen Landfill

Norfolk Naval Base
Norfolk, Virginia

Prepared for

Department of the Navy
Atlantic Division
Naval Facilities Engineering Command

Contract No. N62470-95-D-6007
CTO-0011

August 1996

Prepared by

CH2M HILL
Federal Group, Ltd.
Herndon, Virginia

Contents

Investigation Derived Waste Management Plan

Introduction

The Post Remediation Ecological Monitoring (PREM) of Bousch Creek at the Naval Base, Norfolk (NNB) will produce investigation-derived water wastes. Generation of these wastes will subsequently require waste management and disposal in a manner that eliminates potential hazards to the public. This management plan documents methodologies and procedures that CH2M HILL field personnel will implement to handle, manage and dispose of all investigation-derived wastes.

The investigation-derived wastes (IDW) to be generated during the PREM field investigation include:

- Decontamination fluids generated during the decontamination of sampling equipment.
- Personal Protective Equipment (PPE), such as nitrile gloves and tyvek, used during all phases of the investigation, and expendables used during sampling, such as tubing and sample containers.

Decontamination Fluids

Decontamination fluids as an investigative-derived waste (IDW) will be produced during the field decontamination of sampling equipment.

The amount of IDW decontamination fluids that are to be contained will be minimal, less than 5-gallons. The IDW will be stored in a sealed 5-gallon bucket during the sampling activities. It is anticipated that both the PREM and the Solid Waste Management Unit (SWMU) Confirmatory Investigation (CTO-0012) field activities will take place in early to mid-July. Due to the small volume of decontamination fluids expected to be generated during the PREM, IDW from both investigations will be combined.

The proposed steps for accumulating and handling IDW decontamination fluids are as follows:

1. Decontamination fluids generated during the PREM field activities will be contained in a sealable 5-gallon bucket.
2. At the conclusion of the PREM field sampling activities, the 5-gallon bucket will be emptied into the 55-gallon drum containing IDW decontamination fluids generated during the SWMUs Confirmatory Investigation.
3. Receive TCLP results from the laboratory and write a memorandum to the Navy recommending whether to handle the combined decontamination fluids and groundwater as hazardous or to instruct a subcontractor to dispose of the water.

4. If groundwater is hazardous according to TCLP results or other criteria, CH2M HILL CH2M HILL and Navy will need to negotiate a contract modification for handling hazardous IDW groundwater. The waste, by law, must be handled and disposed in 90 days.

5. CH2M HILL coordinates with subcontractor for the handling and disposal of hazardous groundwater according to regulations. The activity will be responsible for signing all manifests.

Personal Protective Equipment and Expendables

The personal protective equipment worn by CH2M HILL field personnel and CH2M HILL's subcontractors will be placed in plastic bags as they are generated during the PREM field activities. Examples of PPE to be contained include: nitrile gloves, tyvek, and rubber boots. In addition, any expendable items that were contaminated during sampling will be contained in plastic bags. Upon completion of the PREM field activities, all bagged PPE and expendables will be combined with that generated during the SWMUs Confirmatory Investigation.

Personal protective equipment and sampling expendables will be placed in marked bags and discarded in dumpsters if the TCLP results indicate no toxicity hazard. If TCLP results indicate that soils or groundwater are hazardous, the PPE generated during the PREM will be disposed of with that generated during the SWMUs Confirmatory Investigation.

Labeling

Every 55-gallon drum containing combined investigation-derived wastes will be labeled with the following information: the type of IDW (groundwater, soil, or PPE), the date the drum was filled and sealed, and a brief warning not to handle the drum or its contents without permission from the Naval Facilities Engineering Services Command. An example of the information included on each drum is:

Investigation Derived Wastes
Decontamination Fluids - SWMU 06 Investigation
Decontamination Fluids - PREM
4-8-96
Hands Off - Analysis Pending
NFESC

Storing IDW

The IDW decontamination fluid generated during the PREM will be combined with the SWMUs Confirmatory Investigation IDW drums that will be stockpiled within the boundary of SWMU 06.

Disposal and Manifesting

After receipt of test results, CH2M HILL will formulate a preliminary assessment of any potential hazards posed by the IDW, and submit waste management recommendations to the Navy. If the test results indicate that the IDW is not hazardous, CH2M HILL will recommend that the water be disposed of to the industrial wastewater treatment plant and

the PPE be disposed of in a trash dumpster for disposal with other nonhazardous trash generated at the base. Otherwise, the water and PPE will be manifested, handled, treated, and disposed of as a hazardous waste by a subcontractor yet to be identified. The activity will be responsible for signing all manifests.